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Proposed Steam Electric Power Plant, George Neal Steam Electric Station, Neal Unit No. 4, Port Neal Industrial District, Salix, Woodbury County, Iowa

Environmental Protection Agency, Kansas City, Mo.

Prepared for

Army Engineer District, Omaha, Nebr.

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16. ABSTRACT

The U.S. Environmental Protection Agency (EPA) has prepared the statement for the coal-fired, 576 megawatt power plant near Sioux City, Iowa in conjunction with the U.S. Army Corps of Engineers (Corps) and the Rural Electrification Administration (REA). EPA was responsible as lead agency in the project as a result of the plant's need for a new source National Pollutant Discharge Elimination System permit required under Section 402, Public Law 92-500. The Corps' responsibility in the project was pursuant to the project's requirement for Section 404, P.L. 92-500 and Section 10, River and Harbor Act permits. REA was involved with the project as a result of its possible issuances of loan guarantees to local electricity cooperatives. The statement includes analyses of expected impacts upon air and water quality, water quantity, noise levels, land use and aesthetics resulting from construction and operation of the proposed station. Energy source, plant siting, facility design and operation alternatives are described.

17. KEY WORDS AND DOCUMENT ANALYSIS

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January 1977

FINAL

ENVIRONMENTAL IMPACT STATEMENT

for

PROPOSED STEAM ELECTRIC POWER PLANT
GEORGE NEAL STEAM ELECTRIC STATION
NEAL UNIT #4

PORT NEAL INDUSTRIAL DISTRICT
SALIX, WOODBURY COUNTY, IOWA

prepared by

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION VII

KANSAS CITY, MISSOURI

in conjunction with

U.S. ARMY ENGINEER DISTRICT
OMAHA, NEBRASKA
and
RURAL ELECTRIFICATION ADMINISTRATION
WASHINGTON, D.C.

with the assistance of

Envirosphere Company
A Division of Ebasco Services, Inc.
New York, New York

Approved by:

Charles V. Wright
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Acting Regional Administrator

DRAFT ENVIRONMENTAL IMPACT STATEMENT
GEORGE NEAL STEAM ELECTRIC GENERATING STATION
NEAL UNIT 4

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SUMMARY

GEORGE NEAL UNIT 4 STEAM-ELECTRIC GENERATING STATION

( ) DRAFT (X) FINAL

Responsible Office: U.S. Environmental Protection Agency, 1735 Baltimore, Kansas City, Missouri 64108, telephone 816-374-2921.

1. Type of Action: (X) Administrative ( ) Legislative

2. Description of Action: Iowa Public Service Company of Sioux City, Iowa, has applied for a new source National Pollutant Discharge Elimination System permit for the operation of a 576 megawatt coal-fired steam-electric generating facility adjacent to the Missouri River. The station is located approximately 14 miles south of Sioux City, Iowa.

Pursuant to the National Environmental Policy Act of 1969 (PL 91-190), EPA has prepared this final Environmental Impact Statement (EIS) to evaluate the potential environmental impacts of this action upon the Missouri River, Woodbury County, and the surrounding area.

This EIS is a multiagency document, and will serve as the U.S. Army Corps of Engineers' EIS on their possible issuance of a Section 404, Federal Water Pollution Control Act Amendments permit and a Section 10, River and Harbor Act permit. The Iowa Public Service Company has applied for a Department of the Army permit under Section 10 of the River and Harbor Act of 3 March 1899 (30 Stat 1151; 33 U.S.C. 403) and under the provisions of Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (86 Stat 816; 33 U.S.C. 1344) for activities related to the proposed construction of an intake pumphouse, outfall structure, and armored riprap apron for a 576 megawatt coal-fired steam-electric power generating facility on and in the Missouri River at mile 716.64L (1960 mileage). The work will consist of constructing a coffer cell retaining structure, dewatering the work area, excavating approximately 21,800 cubic yards of material, constructing the intake and outfall structures, placing the required backfill, repairing the bank revetment, removing the coffer cell retaining structure, installing approximately 300 linear feet of sheet piling, and placing approximately 1,500 cubic yards of armor riprap aprons in front of the intake and outfall structures. The intake pumps will extract river water at a rate of approximately 707 cubic feet per second for use as condenser coolant in the power generating plant and will be returned to the river through the discharge structure. The statement will also serve as the EIS for the Rural Electrification Administration's possible issuance of a loan guarantee to Cornbelt Power and Northeast Iowa Power Cooperatives to provide for generating facilities and related transmission facilities.

3. Environmental Impacts: The power plant will convert approximately 450 acres of agricultural land and wildlife habitat to industrial use. Combustion for power generation will result in the release of waste by-products into the atmosphere and heated discharge water into the Missouri River. Approximately 50 million tons of coal will be committed during the 30-year life of the facility. The facility is expected to provide for the production and distribution of power to meet present and projected demands. The total cost of the project is estimated at $276 million. Liquid discharges will be those associated with coal pile runoff, plant wastewater treatment systems and sanitary waste treatment systems.

Adverse Environmental Effects: Construction of the station will, to varying degrees, disrupt aquatic and terrestrial habitats. Noise and dust will also result from construction activities. Damage or death of aquatic organisms will result from their impingement on the intake structure and entrainment into the circulating water system during plant operation. The levels of certain air pollutants (e.g., sulfur dioxide, nitrogen oxides, and particulates) are expected to increase.

4. Alternatives: Denial of permit, resulting in no discharge; alternate plant sites; alternate cooling systems; alternate fuels; alternate routes of fuel transportation; alternate methods for the treatment of stack emissions; and alternate ash disposal techniques.

5. Comments Requested:

Federal Agencies

Council on Environmental Quality
U.S. Department of Agriculture
    Forest Service
    Soil Conservation Service
U.S. Department of Commerce
    National Marine Fisheries Service
U.S. Department of Health, Education, and Welfare
U.S. Department of Housing and Urban Development
    Regional Administrator, Region VII
    Area Director
U.S. Department of the Interior
    Special Assistant to the Secretary
    Fish and Wildlife Service
    Bureau of Land Management
    Bureau of Mines
    Bureau of Reclamation

Bureau of Indian Affairs
Bureau of Outdoor Recreation
National Park Service
Office of Land Use and Water Planning
Geological Survey
U.S. Department of Transportation
Federal Highway Administration
Coast Guard
Federal Aviation Administration
Federal Power Commission
National Bureau of Standards
Advisory Council on Historic Preservation
Water Resources Council
Federal Energy Administration
Missouri River Basin Commission

Members of Congress

Richard C. Clark, U.S. Senate
John C. Culver, U.S. Senate
Berkley Bedell, U.S. House of Representatives

State

Iowa "A-95" Coordinator, Governor's Office
Nebraska "A-95" Coordinator, Governor's Office
Lyle Scheelhaase, State Representative
Donald V. Doyle, State Representative
Willis Junker, State Representative
Leonard Anderson, State Senator
E. Kevin Kelly, State Senator
Iowa Department of Environmental Quality
State Library Commission of Iowa

Local and Regional

Mayor, Salix, Iowa
Mayor, Sioux City, Iowa
Woodbury County Conservation Board
Sioux City Public Library

Interested Groups and Individuals

People's Energy Project
Wildlife Society, Iowa Chapter
American Fisheries Society, Iowa Chapter
Audubon Society of Iowa
Sierra Club, Sioux City Chapter
Citizens for Environmental Action
Citizens United for Responsible Energy
Iowa Association of Municipal Utilities
J.N. "Ding" Darling Foundation, Inc.
Izaak Walton League, Sioux City Chapter
Keep Earth's Environment Pure

Nature Conservancy, Iowa Chapter
State Preserves Board
Ducks Unlimited
Iowa Wildlife Federation
Iowa Commercial Fisheries Association
Iowa Ornithologists' Union
Iowa Citizens for Environmental Quality

6. The draft Environmental Impact Statement was sent to Council on Environmental Quality in October 1976.

7. The final Environmental Impact Statement was sent to Council on Environmental Quality in January 1977.

I - INTRODUCTION

A. PURPOSE OF ENVIRONMENTAL IMPACT STATEMENT

The Environmental Protection Agency, Region VII, has determined that an Environmental Impact Statement (EIS) is required before the decision is made on the issuance of the new source National Pollutant Discharge Elimination System (N.P.D.E.S.) permit for the George Neal, Unit 4, Steam Electric Generating Station. This determination is in accordance with the rules and regulations pursuant to Section 102(2)(c) of the National Environmental Policy Act of 1969 (NEPA) and Section 511(c)(1) of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA).

The EIS for the George Neal, Unit 4, station has been prepared to assess the total environmental impacts of the project. It is a joint EIS, prepared in conjunction with the U.S. Army Corps of Engineers for the issuance of a Section 404, Federal Water Pollution Control Act Amendments permit and a Section 10, River and Harbor Act permit. The statement will also serve as the EIS for the Rural Electrification Administration's issuance of loan guarantees for both generating and transmission facilities. Both the Corps of Engineers and the Rural Electrification Administration (REA) have provided extensive input into this document and it is designed to identify the significant impacts of all federal actions involved with this facility.

Section 402 of the Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500, (FWPCA), 33 U.S.C. 1342 established a program whereby every point source pollutant discharger must obtain a permit to continue their wastewater discharge into waters of the United States. This permit program is known as the National Pollutant Discharge Elimination System (NPDES). An individual permit is conditioned so that various levels of discharge control are obtained by certain dates (July 1, 1977, for best practicable control technology available and July 1, 1983, for best available technology economically achievable). These levels of discharge control are established by effluents limitations as promulgated pursuant to Sections 301, 304, 306, 307 and 501 of FWPCA.

The Corps of Engineers' authority over this project stems from Section 10 of the River and Harbor Act of 1899, 33 U.S.C. 403, which governs activities in the "Navigable Waters of the United States" as defined in the Control of Federal Regulations, 33 CFR 209.260. Any activity in a navigable water of the United States below the level of ordinary high water (OHW) requires a permit from the Department of the Army through the Chief of Engineers. A Section 404 permit would also be required under the provision of FWPCA, 33 U.S.C. 1311, 1344. Under Sections 10 and

404, the Corps of Engineers permit authority is only for the construction, operation and maintenance of the intake and outlet structure.

Corn Belt Power Cooperative and Northwest Iowa Power Cooperative have applied to the Rural Electrification Administration for loan guarantees to finance 25 MW and 100 MW, respectively, of the proposed Neal Unit 4. These requests are being evaluated to insure that reasonable safeguards are being taken to protect the health and safety of the public and that all means of practical environmental protection are incorporated to minimize the deleterious effects of the proposed action.

Iowa Public Service Company (IPS) and twelve other private and municipal utilities are the joint owners of the proposed Neal Unit 4, a 576 megawatt (MW) low sulfur coal-fired unit scheduled for commercial operation in May 1979. Table I-A-1 lists the Neal Unit 4 owners including Interstate Power Company (ISP), Northwestern Public Service Company (NPS), Corn Belt Power Cooperative (Corn Belt), Northwest Iowa Power Cooperative (NIPCO) and eight municipal utilities. Approximately 92 percent of the plant's capacity is owned by the five utilities, IPS, ISP, NPS, NIPCO and Corn Belt. Four of these utilities are members of both the Mid-Continent Area Power Pool (MAPP) and the Mid-Continent Area Reliability Coordination Agreement (MARCA). NIPCO and the eight municipal utilities are connected to the MAPP transmission line network.

As the major owner of the unit, IPS has planned the construction of this unit near its existing George Neal Steam Electric Station. The George Neal Station is located fourteen miles south of Sioux City in the Port Neal Industrial District in Woodbury County, Salix, Iowa. A location map of Neal Unit 4 is given in Exhibit I-A-1.

The budgeted installed cost of Neal Unit 4 is $276,000,000 and construction began in March 1975 with the start of site grading and drainage work. In April 1975 work commenced on underground circulating water piping, pile driving, and the turbine generator foundation.

By the end of March 1976 a total of $44,500,000 had been spent on all phases of the project. Of this amount approximately $14,000,000 consists of site specific items including site improvements, earthwork and piling, concrete, circulating water system, underground electric ducts and a portion of engineering and construction service costs. A detailed construction schedule is presented in Exhibit I-A-2.

	Share In Unit 4	
Iowa Public Service Company	43.403%	250 MW
Interstate Power Company	17.361%	100 MW
Northwestern Public Service Company	8.681%	50 MW
Northwest Iowa Power Cooperative	17.361%	100 MW
Corn Belt Power Cooperative	4.861%	28 MW
Algona Municipal Utilities	2.604%	15 MW
Bancroft Municipal Utilities	.347%	2 MW
Coon Rapids Municipal Utilities	.521%	3 MW
Graettinger Municipal Light Plant	.174%	1 MW
Laurens Municipal Light & Power	.521%	3 MW
Milford Municipal Utilities	.347%	2 MW
Spencer Municipal Utilities	1.215%	7 MW
City of Webster City, Iowa	2.604%	15 MW
	100.000%	576 MW

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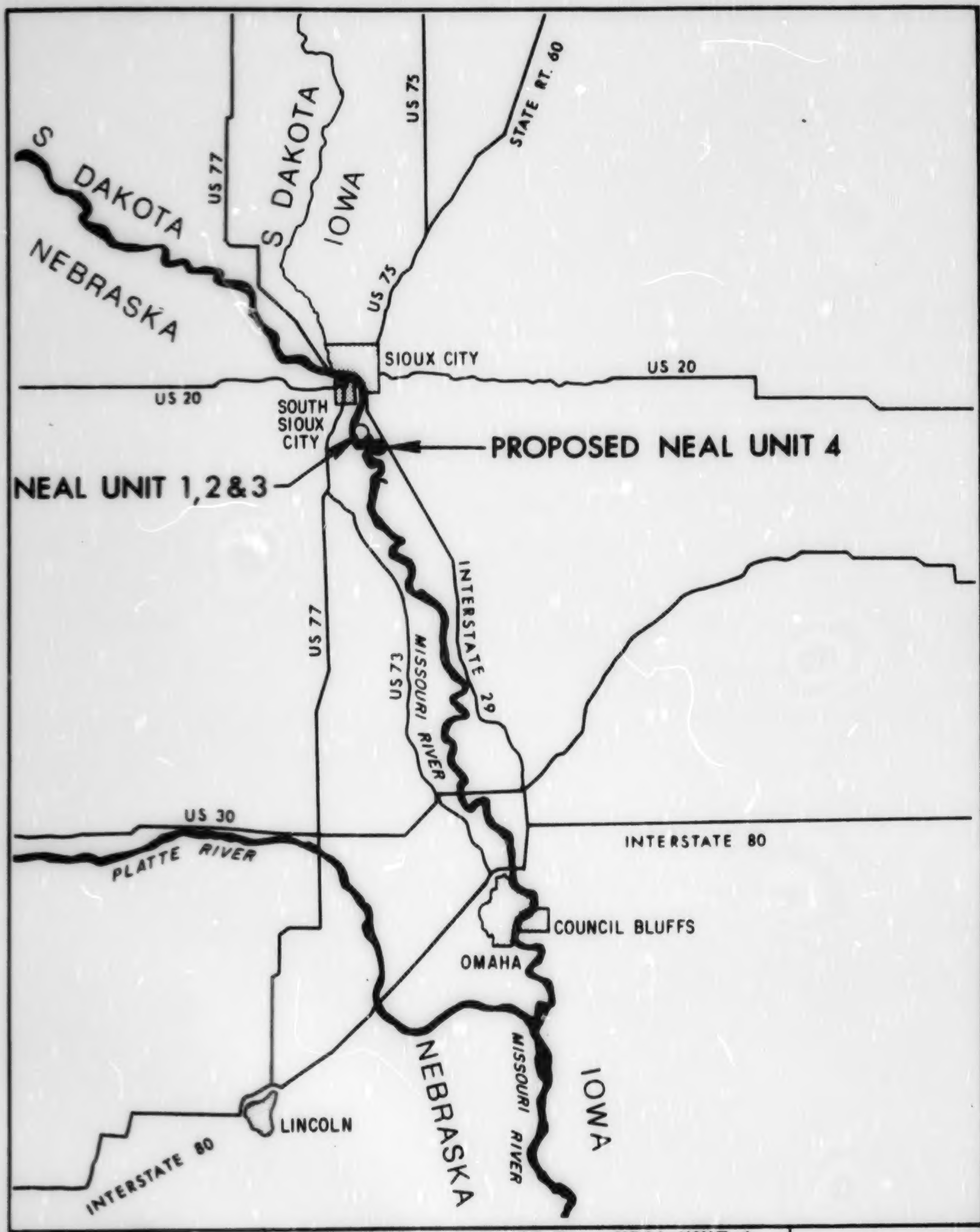
IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

OWNERS OF NEAL UNIT 4

DATE: SCALE:

TABLE
I-A-1


S DAKOTA
NEBRASKA
US 77
S DAKOTA
IOWA
US 75
STATE RT. 60
US 75
SIOUX CITY
US 20
US 20
SOUTH
SIOUX
CITY
PROPOSED NEAL UNIT 4
NEAL UNIT 1,2&3
INTERSTATE 29
MISSOURI RIVER
US 73
US 77
US 30
PLATTE RIVER
INTERSTATE 80
COUNCIL BLUFFS
OMAHA
NEBRASKA
MISSOURI RIVER
IOWA
LINCOLN
INTERSTATE 80

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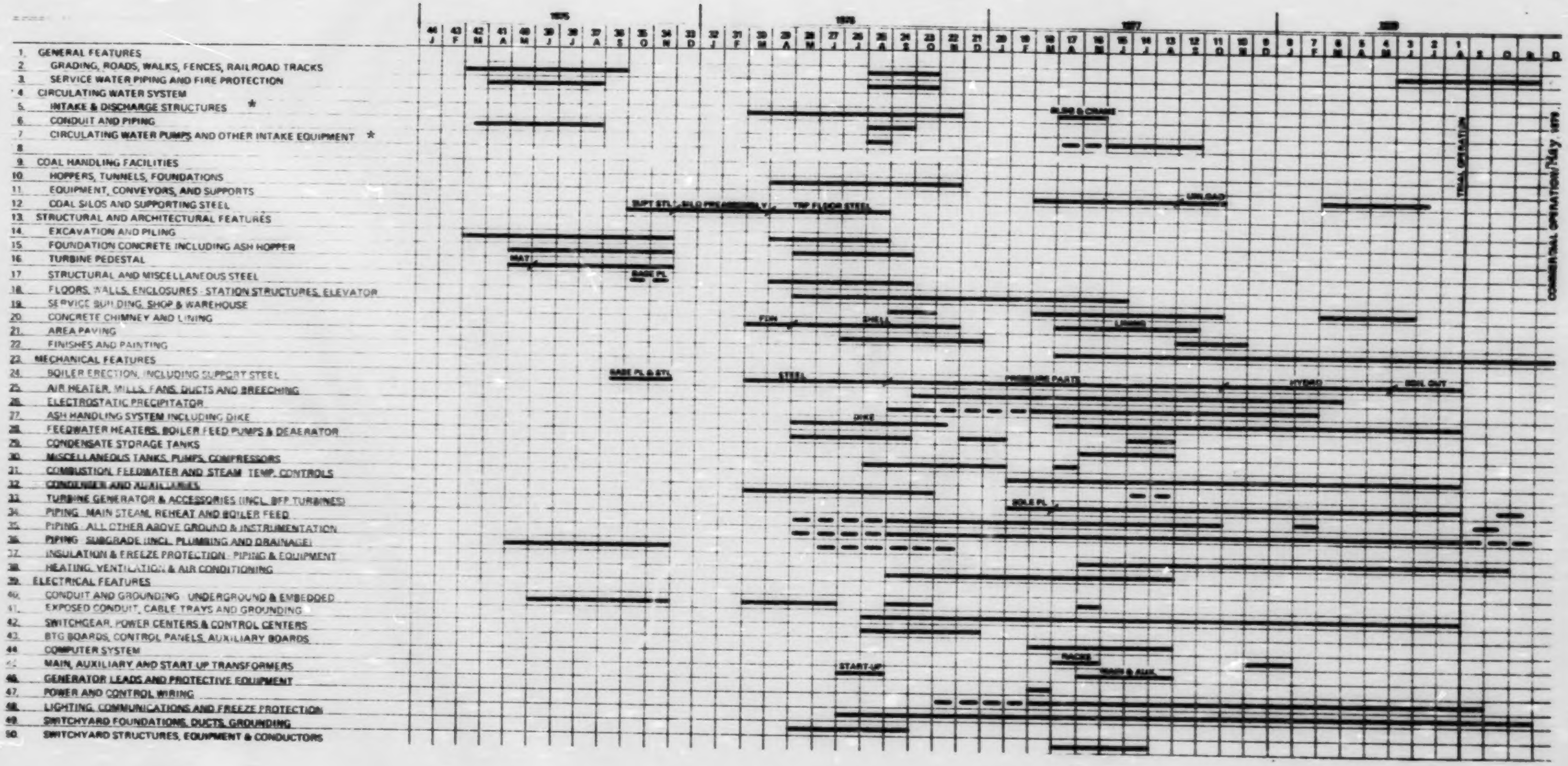
IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

NEAL UNIT 4 LOCATION MAP

DATE:
SCALE:

EXHIBIT
I-A-2



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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

CONSTRUCTION SCHEDULE OF NEAL UNIT 4

DATE:

SCALE:

EXHIBIT
1-A-2

B. PRINCIPAL OWNERS OF THE PROPOSED NEAL UNIT 4

1. Iowa Public Service Company

Iowa Public Service Company (IPS) is the principal owner of the proposed Neal Unit 4 and controls approximately 43 percent of the total shares. As the principal owner, the company is responsible for the design and construction of the facility. IPS has contracted with EBASCO Services, Incorporated to be the major consultant responsible for the design and construction of the Projects. EBASCO, in turn, has commissioned Envirosphere Company (a division of EBASCO) to prepare the environmental assessment of the project. The assessment has been used extensively in the preparation of the EIS.

IPS supplies gas and electric power to approximately twenty percent of the State of Iowa and to a small portion of South Dakota. IPS also supplies gas to the eastern part of the State of Nebraska. This area, as shown in Exhibit I-B-1, borders Waterloo on the east, Audubon on the south, Sioux City on the west, and Rock Valley on the north.

In 1975, IPS provided electric and gas service to a total of 169,299 customers. The population served by IPS was about 400,000 persons.

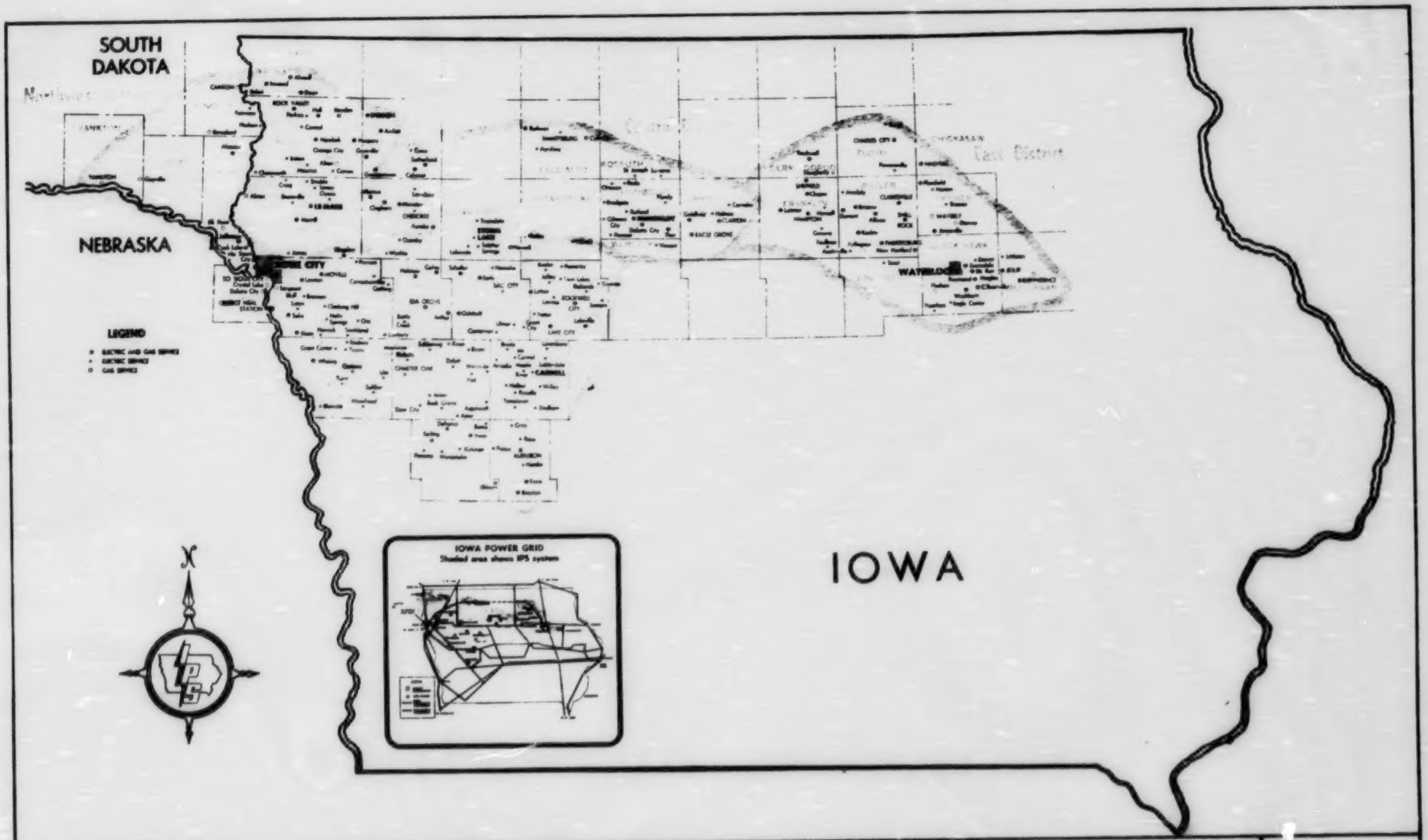
2. Interstate Power Company

Interstate Power Company (ISP), owns over 17 percent interest in the proposed Neal Unit 4. ISP provides natural gas and electric service to 252 communities in more than a 10,000 square mile area within northeast and north central Iowa, southern Minnesota and northwestern Illinois.

The total number of electric customers served by ISP in 1975 was 142,677. The total number of natural gas service customers was 41,357. Dubuque, Iowa with a population of 62,309 is the largest city serviced by ISP.

3. Northwest Iowa Power Cooperative

Northwest Iowa Power Cooperative (NIPCO), which owns 17.361 percent interest in the proposed Neal Unit 4, is a rural electric cooperative owned and controlled by more than 23,000 rural northwest Iowans. NIPCO consists of ten rural electric cooperative members and one municipal electric cooperative member. NIPCO also wheels Bureau of Reclamation power to several municipals in western Iowa. During 1975, the sales to the cooperative members were 422,412,000 kWh which was 2.9 percent over 1974 sales.


SOUTH DAKOTA
Northwest
NEBRASKA
Central
East District
IOWA
WATERLOO
SIOUX CITY
LEGEND
ELECTRIC AND GAS SERVICE
ELECTRIC SERVICE
GAS SERVICE
N
IOWA POWER GRID
Shaded area shows IPS system

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

AREA SERVED BY IOWA PUBLIC SERVICE
COMPANY

DATE:

SCALE:

EXHIBIT
I-B-1

4. Northwestern Public Service Company

Northwestern Public Service Company (NPS), owns 8.681 percent interest in the proposed Neal Unit 4, and has its headquarters in Huron, South Dakota. NPS serves approximately 50,000 electric customers in 108 communities and adjacent rural areas in east-central South Dakota. NPS also provides natural gas service to customers in South Dakota and Nebraska. During 1975, sales totaled 646,953,000 kWh which was 9.75 percent over 1974 sales.

5. Corn Belt Power Cooperative

Corn Belt Power, a rural electric cooperative, owns approximately 4.9 percent interest in the proposed Neal Unit 4. This generation and transmission cooperative is presently composed of 15 members including North Iowa Municipal Electric Cooperative (NIMECA), eight members of which are participants in the proposed Neal Unit 4 project. In 1975, Corn Belt sold in excess of 923 million kWh of electric energy.

C. NEED FOR POWER

1. Regional Supply and Demand

a. Mid-Continent Area Reliability Coordination Agreement (MARCA) Region

The Federal Power Commission (FPC), which was created by Act of Congress to protect consumers, has the overall responsibility for surveying power demand and supply, compiling records and auditing accounting records of utility companies throughout the United States. MARCA has been created in accordance with FPC directives by the utilities within the States of Minnesota, Iowa, North Dakota, most of South Dakota, most of Nebraska, and portions of the States of Wisconsin, Illinois and Montana as outlined in Exhibit I-C-1. MARCA provides an overview of the planning and operating activities in the region to ensure reliability of power generation and supply. The overview of regional planning is provided by a specific annual reporting procedure to MARCA by each system on load forecasts, new facilities planned, and the resulting generating capability and reserve of the overall projected system. MARCA was organized in 1968 and presently has a membership of 22 larger systems consisting of 11 investor-owned, 8 Generation & Transmission cooperatives, 2 public power districts and a federal agency (U.S. Bureau of Reclamation). Otter Tail Power Company, a non-MARCA member, operates in the MARCA region. Data for this utility is included in the regional reports. Manitoba Hydro-Electric Board is an associate member of MARCA; however, data for this Canadian utility are not included in the reports. All 22 MARCA utilities, along with 12 smaller utilities, are members of the Mid-Continent Area Power Pool (MAPP), Basin Electric Power Cooperative having joined MAPP during 1975.

i. System Adjusted Net Capability*

The projected adjusted net capability for the MARCA region for the year 1976 is approximately 20,200 MW.

Exhibit I-C-2 presents the projected adjusted net capability for MARCA participants for the years 1976 through 1985. As shown on this exhibit, the adjusted net capability of MARCA members is anticipated to increase to about 32,400 MW by the year 1985.

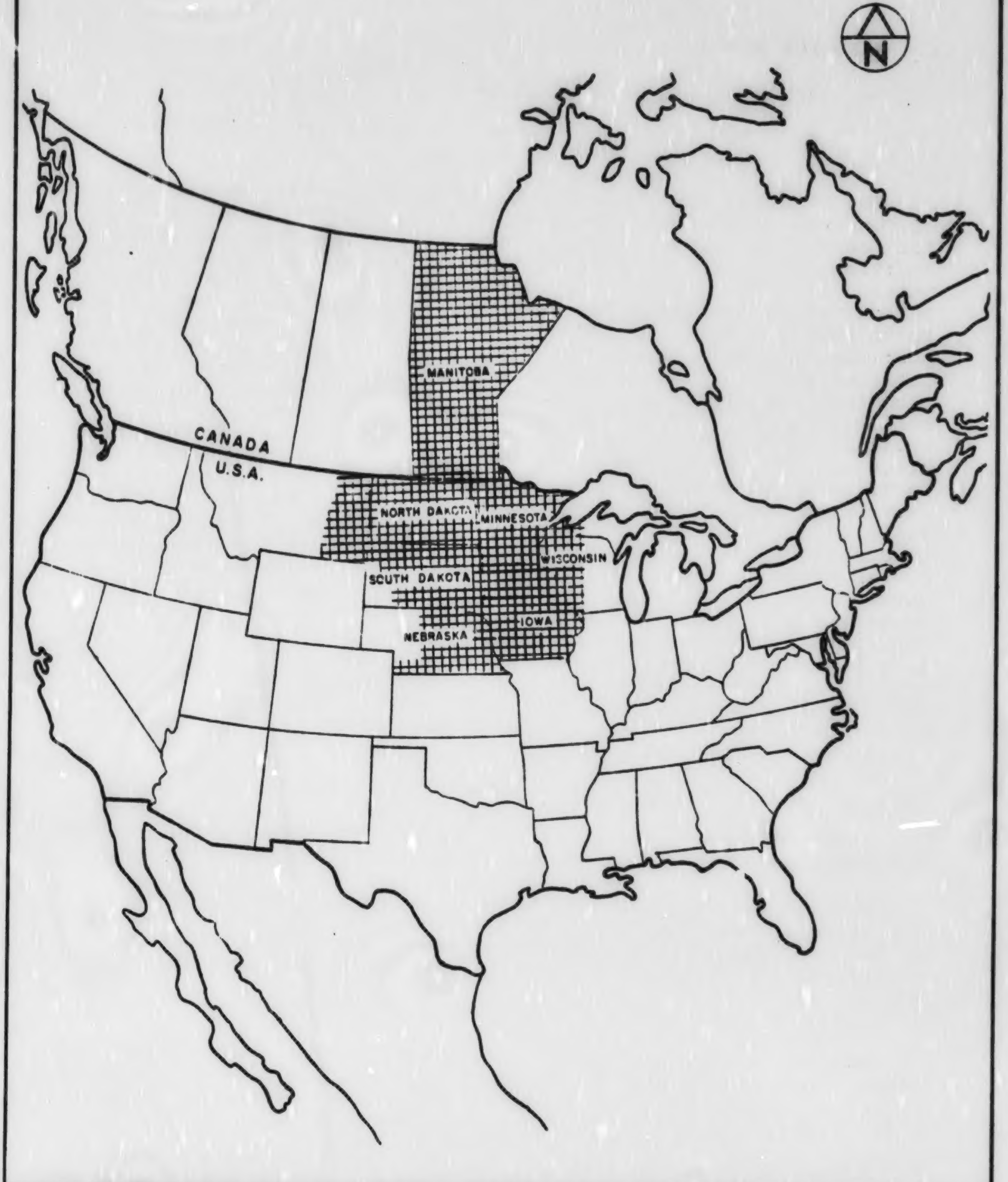
ii. Total Firm Capacity Obligation**

Based on projected sales, projected seasonal peak demand and other firm commitments of MARCA participants, the total firm capacity obligation is expected to increase from 19,200 MW in 1976 to about 33,200 MW in 1985, as shown in Exhibit I-C-2.

---

* Adjusted Net Capability - defined as the net generating capability plus participation purchases less participation sales.

** Total Firm Capacity Obligation - defined as seasonal adjusted net demand plus net reserve capacity obligation.


N
MANITOBA
CANADA
U.S.A.
NORTH DAKOTA
MINNESOTA
WISCONSIN
SOUTH DAKOTA
IOWA
NEBRASKA

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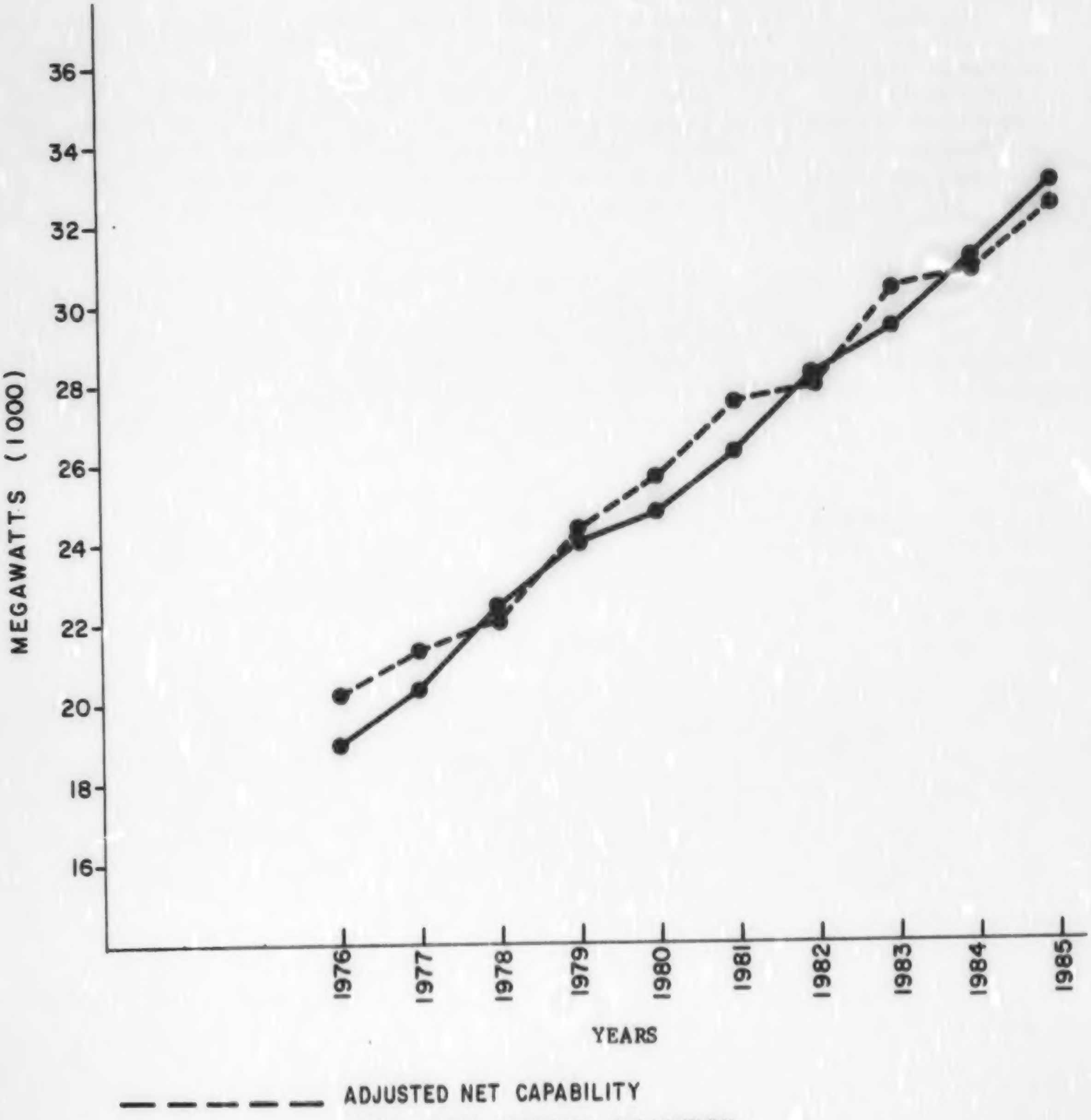
IOWA PUBLIC SERVICE CO. - NEAL UNIT 4

MID-CONTINENT AREA RELIABILITY COORDINATION AGREEMENT REGION

EXHIBIT I-C-1

DATE:

SCALE:



Data Source: A Report by Mid-Continent Area Reliability Co-ordination Agreement (MARCA) to the Federal Power Commission Pursuant to FPC Docket R-362, Appendix A-1, April 1, 1976

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

PROJECTED TOTAL FIRM CAPACITY OBLIGATION AND ADJUSTED NET CAPABILITY OF MID-CONTINENT AREA RELIABILITY COORDINATION AGREEMENT REGION - 1976 to 1985

DATE:

EXHIBIT

I-C-2

iii. System Deficiency*

Exhibit I-C-2 indicated that the total firm capacity obligation for the MARCA region is expected to exceed its adjusted net generating capability for a short period in 1978-1979 and for the period 1984-1985. At the projected rate of demand increase, the capacity deficiency is anticipated to be about 800 MW in 1985. As a result, MARCA members are planning the net addition of generating capability including Neal Unit 4 over the period 1976-1985 to meet their system demands.

b. Mid-Continent Area Power Pool (MAPP) Region

IPS is one of 22 electric utilities constituting the MAPP membership. This power pool was formed in March, 1972. Its purpose is to coordinate generation and transmission of electric energy to the general public and to other electric distributing agencies in the state of Iowa and neighboring states. One of the major objectives of MAPP is to coordinate the activities of its members in planning, constructing and operating an integrated electric power system utilizing the latest technological facilities and fuel resources with minimal environmental impact.

The operating areas of the MAPP members are in close proximity. Their systems are already interconnected by transmission lines which enables them to serve their customers synchronously. The coordinated activities of MAPP are also shared by non-member utilities. For instance, among the owners of the proposed Neal Unit 4, NIPCO and eight municipal utilities are not MAPP members but they are interconnected to the MAPP system. The list of MAPP members is given in Table I-C-1.

The MAPP members, and consequently their customers, realize many benefits (i.e. economic, reliability, etc) as a result of coordinated installation, operation, generation and transmission of electrical energy.

All 22 members of MAPP are participants of MARCA and, as such, are included in the annual regional report prepared by MARCA.

i. System Adjusted Net Capability

The adjusted net capability of MAPP members for the year 1976 is projected to be about 19,870 MW. Exhibit I-C-3 presents the projected adjusted net capability for MAPP members for the years 1976 through 1985. As shown in this exhibit, the adjusted net capability of MAPP members is anticipated to increase to about 31,880 MW by the year 1985.

---

* System Deficiency - defined as total firm capacity obligation minus adjusted net capability.

Mid-Continent Area Power Pool
Member Utilities

Basin Electric Power Cooperative

Central Iowa Power Cooperative

Cooperative Power Association

Corn Belt Power Corporation

Dairyland Power Corporation

Eastern Iowa Light and Power Corporation

Interstate Power Company

Iowa Electric Light and Power Cooperative

Iowa-Illinois Gas and Electric Company

Iowa Power and Light Company

Iowa Public Service Company

Iowa Southern Utilities Company

Lake Superior District Power Company

Minnesota Power & Light Company

Minnkota Power Cooperative, Inc

Montana-Dakota Utilities Company

Nebraska Public Power District

Northern States Power Company

Northwestern Public Service Company

Omaha Public Power District

United Power Association

United States Bureau of Reclamation

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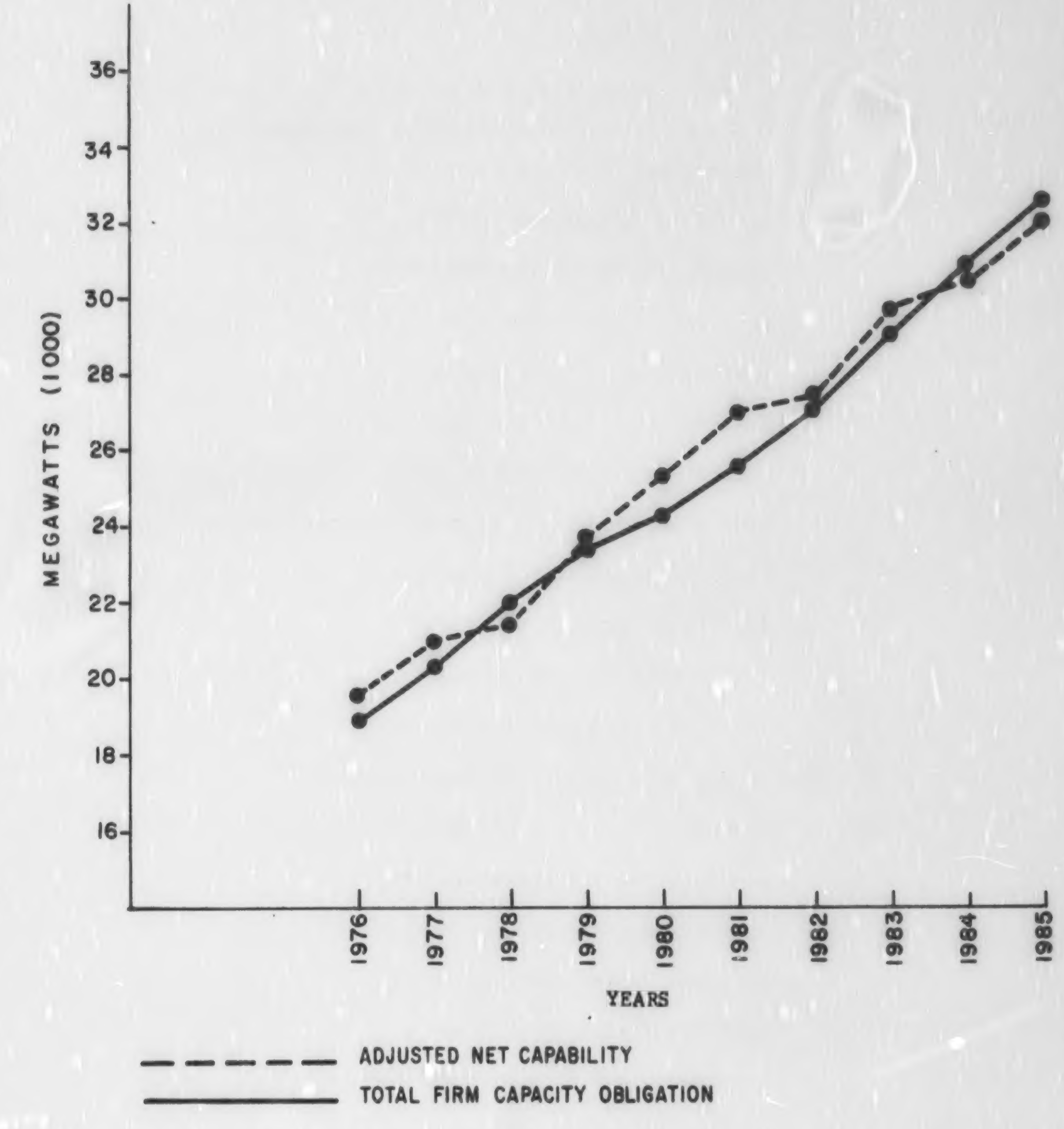
IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

MEMBERS OF MID-CONTINENT AREA POWER POOL

DATE: SCALE:

TABLE I-C-1



Data Source: A Report by Mid-Continent Area Reliability Co-ordination Agreement (MARCA) to the Federal Power Commission Pursuant to FPC Docket R-362, Appendix A-1, April 1, 1976

envirosphere company A DIVISION OF EBASCO SERVICES INCORPORATED	IOWA PUBLIC SERVICE Co. - NEAL UNIT 4	EXHIBIT
	PROJECTED TOTAL FIRM CAPACITY OBLIGATION AND ADJUSTED NET CAPABILITY OF MID-CONTINENT AREA POWER POOL MEMBERS	EXHIBIT I-C-3
	DATE:	

ii. Total Firm Capacity Obligation

Based on projected sales and other firm commitments, the total firm capacity obligation of MAPP members is expected to increase from 18,850 MW in 1976 to 32,640 MW in 1985 as shown in Exhibit I-C-3.

iii. System Deficiency

Exhibit I-C-3 indicates that the total firm capacity obligation of the MAPP members will exceed the adjusted net generating capability for the periods 1977-1979 and 1983-1985. At the projected rate shown in this exhibit, the capacity deficiency of MAPP will be 760 MW in 1985. As a result, MAPP members are planning the net addition of generating capability over the period 1976-1985 to meet their system demands. The operation of Neal Unit 4 can provide a portion of the additional generating capability.

2. Iowa Public Service Company - Supply and Demand

a. System Adjusted Net Capability

The net generating capabilities of the power plants owned by IPS are presented in Table I-C-2. The adjusted net capability of IPS at the end of the year 1975 was 855 MW.

The projected adjusted net capability of IPS for the year 1976 through 1985 is presented in Exhibit I-C-4. This exhibit does not include consideration of the proposed Neal Unit 4. Moreover, for the years beyond 1976, the projections assume that net generating capability will equal adjusted net generating capability; therefore, these projections assume that IPS will not have participation sales of electrical energy during this period.

b. Total Firm Capacity Obligation

IPS's total energy sales for the year 1975 were approximately 2,431,000,000 kilowatt-hours (kW-hr), about 10 percent higher than the prior year. Approximately 2,387,000,000 kW-hr of net sales were to ultimate customers and the remaining 53,000,000 kW-hr were sold to other utilities for resale. The 1975 energy sales to various customer categories are given in Table I-C-3. Load growth projections indicate that the required energy demand will increase significantly due to population growth, increased per capita consumption of electricity and generally increasing industrial use.

While IPS must have reliable generating capability throughout the year to meet its users' requirements, it must also have the capability to provide electricity during times of peak demand. In this connection, MARCA requires IPS to meet a total firm capacity obligation of 881 MW in 1976. As shown in Exhibit I-C-4, the total firm capacity obligation of IPS is expected to

Name and Location of Station		Capability (kilowatts)
Steam Electric		
Neal*	Sioux City	573,000
Maynard	Waterloo	81,000
Kirk	Sioux City	18,500
Hawkeye	Storm Lake	22,786
Carroll	Carroll	10,611
Eagle Grove	Eagle Grove	9,842
Total Steam Electric		715,739
Internal Combustion		
Neal	Sioux City	5,500
Sheldon	Sheldon	1,790
Storm Lake	Storm Lake	2,200
Sac City	Sac City	2,300
Audubon	Audubon	2,550
Emmetsburg	Emmetsburg	2,200
Cherokee	Cherokee	2,050
Hampton	Hampton	1,800
Ida Grove	Ida Grove	1,600
Carroll	Carroll	1,750
Eagle Grove	Eagle Grove	1,250
Total Internal Combustion		24,990
Gas Turbine*		
Electrifarm	Waterloo	77,400
Parr Station	Charles City	36,420
Total Gas Turbine		113,820
Total - All Stations Operated		854,549

*Winter capability rating

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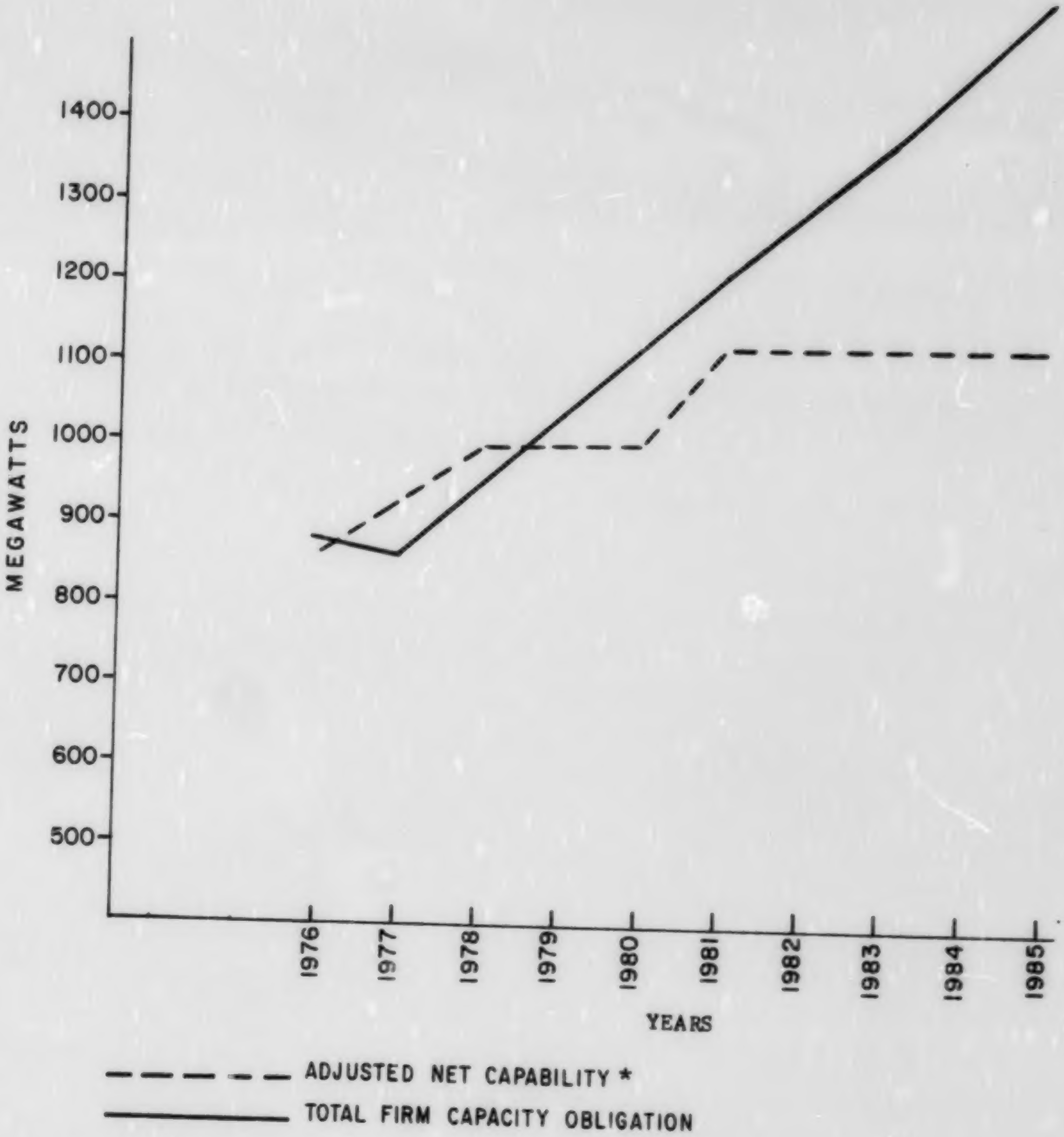
IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

NET GENERATING CAPABILITIES OF POWER
PLANTS OWNED BY IOWA PUBLIC SERVICE COMPANY

DATE: SCALE:

TABLE
I-C-2

Reproduced from best available copy.



*includes 125 MW IPS ownership in Ottumwa Unit in 1981.

Data Source: A Report by Mid-Continent Area Reliability Coordination Agreement (MARCA) to the Federal Power Commission Pursuant to FPC Docket R-362, Appendix A-1, April 1, 1976

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

PROJECTED TOTAL FIRM CAPACITY OBLIGATION
AND ADJUSTED NET CAPABILITY OF IOWA
PUBLIC SERVICE COMPANY - 1976 to 1985

DATE: SCALE:

EXHIBIT
I-C-4

Sales to Ultimate Customers	kW-hr (thousands)
Residential	924,193
Commercial	653,754
Industrial	607,251
Public Street & Highway Lighting	33,173
Other Sales to Public Authorities	159,050
TOTAL Sales to Ultimate Customers	2,377,421
Sales for Resale	53,368
GRAND TOTAL	2,430,789

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

ENERGY SALES BY IOWA PUBLIC SERVICE COMPANY
IN 1975

DATE:
SCALE:

TABLE
I-C-3

increase at approximately a six percent growth rate to about 1560 MW in 1985.

c. System Deficiency

Exhibit I-C-4, which does not include the addition of the proposed Neal Unit 4, shows that total firm capacity obligation for the IPS system will exceed its adjusted net capability in 1979. At the projected rate of increase in total firm capacity obligation and without the addition of the proposed Neal Unit 4, the IPS system will have an energy deficiency of 438 MW by 1985.

3. Other Major Neal 4 Owners

a. Interstate Power Company (ISP)

Based on the projected data as reported to MARCA, the total firm capacity obligation of ISP is expected to increase from 708 MW in 1976 to 1156 MW in 1985, and the adjusted net capability is expected to increase from 708 MW in 1976 to 1049 MW in 1985. This would result in a system deficiency of 107 MW in 1985.

b. Northwest Iowa Power Cooperative (NIPCO)

Based on its projected system demand plus additional commitments to associated municipal utilities and other rural cooperatives, NIPCO requires the addition of 100 MW from the proposed Neal Unit 4 to help meet its total firm capacity obligation in 1985.

c. Northwestern Public Service Company (NPS)

Based on the projected data as reported to MARCA, the total firm capacity obligation of NPS is expected to increase from 202 MW in 1976 to 397 MW in 1985, and the adjusted net capability is expected to increase from 202 MW in 1976 to 312 MW in 1985. This would result in a system deficiency of 85 MW in 1985.

d. Corn Belt Power Cooperative

The projected data as reported to MARCA indicates the total firm capacity obligation of Corn Belt is expected to increase from 124 MW in 1975 to 237 MW in 1985, and the adjusted net capability is expected to increase from 169 MW in 1974 to 178 MW in 1985. This would result in a system deficiency of 59 MW in 1985.

4. Summary

According to the information presented above, both MARCA and MAPP are planning on the addition of Neal Unit 4 to help meet their system demand commitments over the period from 1976 to 1985. IPS has projected that, despite its conservation efforts, its total firm capacity obligation will exceed its adjusted net capability in 1979 resulting in a system deficiency of 438 MW by 1985. In addition, each of the other major owners of the proposed Neal Unit 4 (ISP, NIPCO, NPS, Corn Belt) projects system deficiencies by 1985. Consequently, the proposed Neal Unit 4 electric generating unit is essential to the fulfillment of the need for power for the five utilities and is an integral part of the future plans of the regional area power pool.

II - DESCRIPTION OF THE PROJECT

A. THE EXISTING PLANT - UNITS 1, 2 AND 3

1. General

The existing George Neal Steam Electric Station is located on a 500 acre site in the Port Neal Industrial District on the east bank of the Missouri River. Exhibit II-A-1 is a plot plan of the existing station.

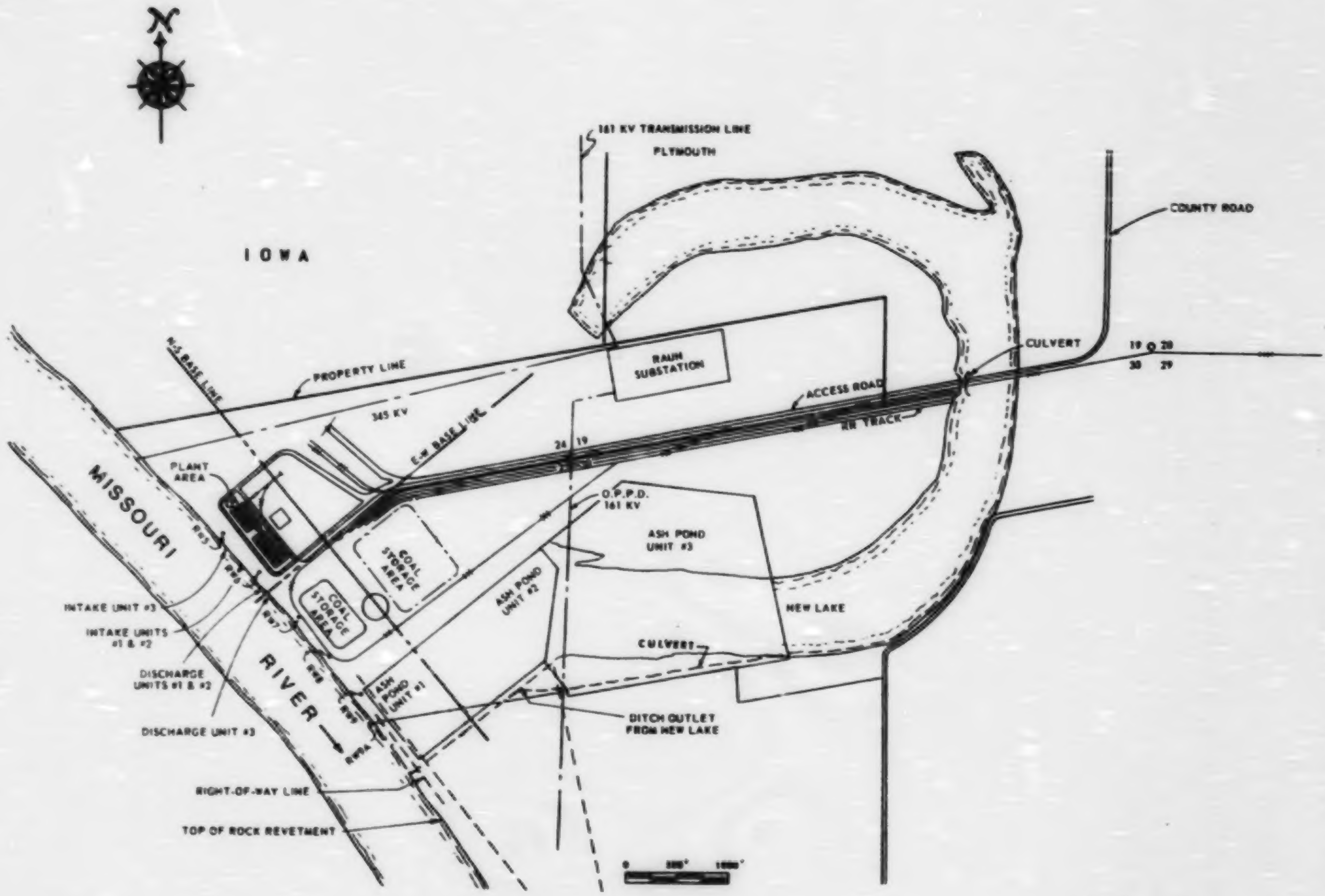
The plant is presently equipped with three coal-fired units with a combined generating capacity of 997 megawatts (MW). Unit 1, having a generating capacity of 147 MW, was put into commercial operation in 1964. This unit has a cyclone type boiler designed to operate on coal, natural gas, or the combination of the two fuels. Unit 2, having a rated generating capacity of 330 MW, was put into commercial operation in 1972. This unit has a pulverized coal type boiler and is designed to use coal with gas igniters. Unit 3, a low sulfur pulverized coal-fired unit, with a generating capacity of 520 MW, was put into commercial operation in December 1975.

2. Circulating Water System

All three units at the plant are designed with a once-through circulating water system. Units 1 and 2 withdraw water from a common intake structure on the Missouri River. To remove waste heat generated by the steam cycle, approximately 75,150 gallons per minute (gpm) and 130,500 gpm of cooling water are passed through the Unit 1 and 2 condensers, respectively. The cooling water is then discharged through a common seal well downstream of the intake structure. The average temperature rise of the Unit 1 and 2 discharge is about 22°F during plant operation at 100 percent capacity factor.

The Unit 3 circulating water system operates in a similar manner to Units 1 and 2. Water is withdrawn from a conventional intake structure on the Missouri River about 200 feet upstream from the Units 1 and 2 intake structure. Approximately 286,200 gpm of condenser cooling water is circulated through the plant and then discharged back to the river adjacent to the Units 1 and 2 discharge at a temperature rise of about 17.8°F during plant operation at 100 percent capacity factor. The discharge is made through a seal well adjacent to the Units 1 and 2 discharge structure.

The combined flow of the Units 1-3 discharge is approximately 491,850 gpm with a combined temperature rise of about 19.5°F during plant operation at 100 percent capacity factor and a combined temperature rise of 16.5°F at an 85 percent daily average capacity factor.


N
IOWA
161 KV TRANSMISSION LINE
PLYMOUTH
COUNTY ROAD
CULVERT
19
20
30
29
RAUN SUBSTATION
PROPERTY LINE
N-S BASE LINE
345 KV
E-W BASE LINE
ACCESS ROAD
RR TRACK
24
19
PLANT AREA
MISSOURI
RIVER
RW5
RW6
RW7
RW8
RW9
RW9A
O.P.P.D. 161 KV
ASH POND UNIT #3
COAL STORAGE AREA
COAL STORAGE AREA
ASH POND UNIT #2
ASH POND UNIT #1
NEW LAKE
CULVERT
DITCH OUTLET FROM NEW LAKE
INTAKE UNIT #3
INTAKE UNITS #1 & #2
DISCHARGE UNITS #1 & #2
DISCHARGE UNIT #3
RIGHT-OF-WAY LINE
TOP OF ROCK REVETMENT
0
500'
1000'

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

GEORGE NEAL STEAM ELECTRIC STATION - THE EXISTING PLANT

DATE:

SCALE:

EXHIBIT
II-A-1

3. Air Quality Control System

Air quality control is implemented for the existing units through the use of low sulfur coal, efficient combustion, high efficiency electrostatic precipitators and an elevated release of combustion products into the atmosphere.

The coal burned at the existing Neal Station has an average sulfur content of about 0.6 percent and an ash content of about 15 percent. Typical (average) characteristics of this coal are presented in Table II-A-1.

It should be noted that the results of an analysis of the coal delivered to the Neal Station from the existing mine at Hanna, Wyoming during 1975 vary from the typical coal characteristics presented in Table II-A-1. In particular, the recent coal analysis shows a reduction in ash and sulfur content in the coal burned during 1975. The ash content is reduced from an average value of 15 percent as addressed in this report to an average value of about 11 percent. The sulfur content addressed in this report was 0.6 percent average and 0.9 percent maximum. This is reduced to an average of 0.5 percent and a maximum of about 0.6 percent. The reduced environmental impacts associated with burning this improved quality coal are discussed briefly in Chapter IV. A summary of the 1975 coal analysis is as follows:

	Typical	Minimum	Maximum
Percent Moisture	12.38	11.16	13.86
Percent Ash	10.95	8.77	13.32
Percent Sulfur	0.49	0.36	0.58
High Heat Value - Btu/lb (as fired)	10,020	9,646	10,532

The amount of air consumed in each furnace during combustion is 20 percent above the stoichiometric air-to-fuel ratio, resulting in maximum combustion efficiency and minimum production of unburned hydrocarbons, carbon monoxide and soot. However, nitric oxide production increases moderately as the amount of excess air rises beyond that dictated by the stoichiometric ratio.

The incombustible heavier particles, mainly bottom ash, resulting from coal combustion settle out of the combustion zone into bottom ash hoppers. The finer particles, consisting mainly of airborne fly ash and soot, are collected by electrostatic precipitators.

The electrostatic precipitator for Unit 1 is a hot side precipitator with a guaranteed particulate removal efficiency of 99 percent. The precipitator is presently operating at 93-95 percent collection efficiency apparently due to the high carbon content of the ash. This problem is expected to be obviated with the installation of a coal blending system presently under study.

Typical Coal Characteristics

Proximate Characteristics	Percent by Weight
Volatile Matter	29.00
Fixed Carbon	38.00
Moisture	18.00
Ash	15.00
	100.00
Ultimate Characteristics	
Carbon	49.69
Hydrogen	4.50
Sulfur	0.61
Nitrogen	1.20
Oxygen	11.00
Moisture	18.00
Ash	15.00
	100.00

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IOWA PUBLIC SERVICE Co. – NEAL UNIT 4

TYPICAL CHARACTERISTICS OF COAL USED
AT UNITS 1, 2 AND 3

DATE: SCALE:

TABLE
II-A-1

The precipitator for Unit 2 is a cold side precipitator with a guaranteed particulate removal efficiency of 99 percent. The precipitator does not meet its guaranteed collection efficiency and is presently operating under a consent order from Region VII of the EPA (dated August 7, 1975) which stipulates that compliance with the State of Iowa Air Quality Standards must be achieved by October 1, 1978. Tests, the results of which have been favorable, have been conducted using gas conditioning to improve collection efficiency and a determination will be made whether gas conditioning, an add-on precipitator, or a combination of these methods will be used to bring the precipitator to guaranteed efficiency. Since the tests were not conclusive by August 1, 1976, an extension of time is being sought. The electrostatic precipitator for Unit 3 is a cold side precipitator with a guaranteed particulate removal efficiency of 99.6 percent. This precipitator is operating at guaranteed collection efficiency.

Based on guaranteed collection efficiencies, the maximum particulate emission rate from any unit is 0.13 pounds per million Btu (lb/mB) of heat input which is well within the allowable Iowa emission standard for particulates for existing units.

A combination of low sulfur content and high heating value for the coal burned in these units results in a maximum sulfur dioxide emission rate of 1.3 lb/mB which is well within the Iowa emission standard (5.0 lb/mB) for existing coal-fired units.

Nitric oxide (NO) is the remaining major gaseous pollutant that a fossil-fuel electric generating station is capable of releasing into the atmosphere at a significant rate. After release into the atmosphere NO is oxidized, either directly or by the much quicker photochemical reaction, to the more toxic nitrogen dioxide (NO2). Concentrations of NO and NO2 will henceforth be referred to as oxides of nitrogen (NOx).

Conventional NOx control techniques, based on limiting the reaction of nitrogen and oxygen to NO in the combustion zone, are applied at the existing units.

Maximum emission rates calculated for the existing units are shown in Table II-A-2.

4. Boiler Stacks

The stack for Unit 1 is 250 feet high and has an inside diameter of 10.2 feet at the top. This stack is designed to release combustion gases at an exit temperature of 300°F and an exit velocity of 95 feet per second (fps). The stack for Unit 2 is 300 feet high and has an inside diameter of 15.25 feet at the top. This stack is designed to release combustion gases at an exit temperature of 263°F and exit velocity of 90 fps.

Emissions (Lb/Hr)[a]	Unit 1	Unit 2	Unit 3	Units 1, 2 And 3 Total
Nitrogen	1,110,000	2,310,000	3,760,000	7,180,000
Oxygen	74,600	155,000	252,000	482,000
Water Vapor	115,000	239,000	388,000	742,000
Carbon Dioxide	300,000	624,000	1,010,000	1,934,000
Sulfur Dioxide[b]	2,970	6,180	10,020	19,170
Nitrogen Oxides	2,080	2,470	4,010	8,560
Particulates[c]	150	410	270	830
Emissions				
Nitrogen Vol (%)	71.8	71.8	71.8	71.8
Oxygen Vol (%)	4.2	4.2	4.2	4.2
Water Vapor Vol (%)	11.6	11.6	11.6	11.6
Carbon Dioxide Vol (%)	12.3	12.3	12.3	12.3
Sulfur Dioxide (Ppm)	560	470	560	–
Nitrogen Dioxide (Ppm)	820	470	470	–
Particulates (GR/ACF)	0.02	0.046	0.23	–
Total Flue Gas (ACFM)	529,000	1,150,000	1,680,000	3,260,000
Sulfur Dioxide (Lb/mB)	2.0	2.0	2.0	2.0
Nitrogen Dioxide (Lb/mB)	2.5	1.0	1.0	1.0
Particulates (Lb/mB)	0.1	0.13	0.053	0.081

a/ Coal at 9000 Btu/Lb.

b/ For Maximum Sulfur Content of 0.9% with all fuel Sulfur as SO_2 for Unit 1-3.

c/ Unit 1 - 40% of Coal Ash as furnace bottom Ash. 99.0% efficient electrostatic precipitator.
Unit 2 - 20% of Coal Ash as furnace bottom Ash. 99.0% efficient electrostatic precipitator.
Unit 3 - 20% of Coal Ash as bottom Ash. 99.6% efficient electrostatic precipitator.

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

MAXIMUM EMISSIONS FROM UNITS 1, 2 AND 3
AT FULL CAPACITY OPERATION

DATE:

SCALE:

TABLE
II-A-2

The stack for Unit 3 is 400 feet high and has an inside diameter of 19.75 feet at the top. The stack releases combustion gases at an exit temperature of 254°F and exit velocity of 90 fps.

The UTM coordinates for the boiler stacks at the existing Neal Station are as follows:

	Latitude	Longitude
Unit 1	42° - 18' - 40"N	96° - 22' - 25"W
Unit 2	42° - 18' - 40"N	96° - 22' - 25"W
Unit 3	42° - 19' - 40"N	96° - 22' - 23"W

5. Chemical Waste System

Sources of chemical wastes from the existing units include boiler blowdown, demineralizer regeneration waste water and sanitary wastes. The boiler blowdown and demineralizer regeneration wastes are discharged into the river with the circulating water system effluent. The sanitary wastes are treated in septic tanks and the effluent is discharged to a sand filter type leaching field.

6. Water Treatment System

Makeup water for the existing boilers is presently provided by wells. The treatment processes required for the boiler feedwater consist of softening, gravity settling, filtration and demineralization. Water is softened by using lime and alum and the resulting suspensions are settled with inert solids present. Because the source is well water, minimal suspended solids enter the softening units. Following the settling process, the water is filtered to remove all remaining solid particles and then passed through the demineralizers. This process initially consisted of two trains of cationic and anionic exchangers for Units 1 and 2. Two more trains of appropriate size were added for Unit 3.

The settled solids are discharged to a seal well in the circulating water system. The solids are soluble in and are diluted by the large flow of water; therefore, only a slight increase in the dissolved solids concentration of the discharge water is observed.

The filter backwashes are also discharged into the circulating water system.

Condensate polishing demineralization was installed to clean the system prior to initial start-up and prior to restarts. The process is not in service during normal operation.

7. Ash Handling System

Bottom ash sluiced from the boilers and fly ash from the electrostatic precipitators are conveyed from each unit to ash disposal ponds.

The bottom ash from Unit 1 is pumped to an 11.7 acre pond and fly ash from Unit 1 and bottom and fly ash from Unit 2 are pumped to a 28.6 acre pond. Unit 3 is equipped with a 73 acre ash pond located northeast of and adjacent to the Unit 2 pond. Unit 3 is also equipped with a fly ash silo designed to load trucks for off-site disposal.

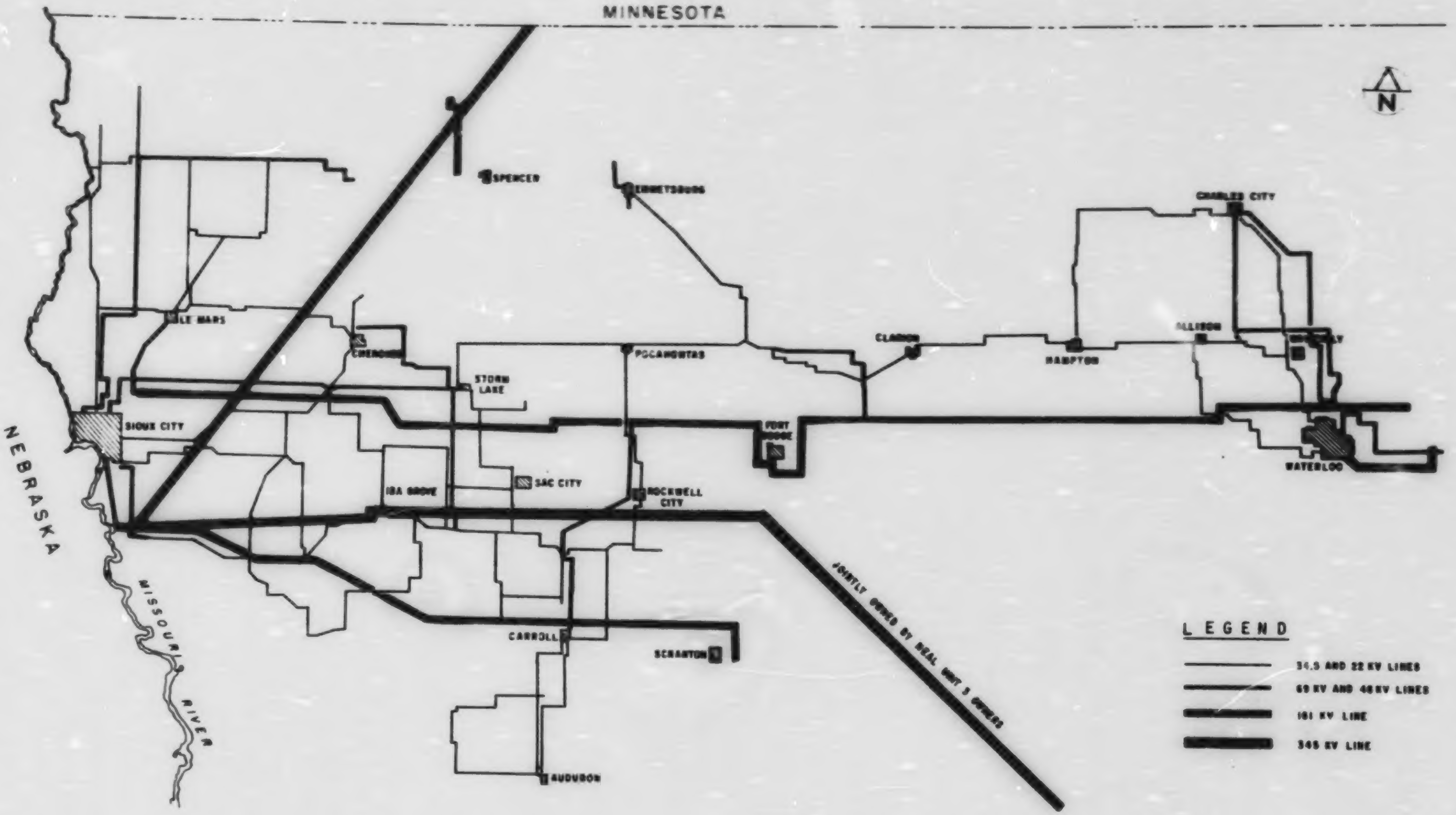
Ash pond walls are constructed from graded and compacted material, free of organic components, and obtained from excavation within the pond area.

8. Transmission Facilities

Iowa Public Service Company (IPS) maintains direct interconnections with Corn Belt Power Cooperative, Iowa-Illinois Gas & Electric, Iowa Electric Light & Power - Central Iowa Power Cooperative, Interstate Power Company, United States Bureau of Reclamation and Omaha Public Power District. In addition, IPS is a part of a 345 kV network which links the Mid Continent Area Power Pool with St. Louis, Minneapolis - St. Paul, St. Joseph, Wichita and Kansas City. A terminal of this network is located within the Port Neal Industrial District.

The existing 161 kV switchyard serves the 147 MW Unit 1 and the 330 MW Unit 2. The existing 345 - 161 kV Raun Substation has been expanded to provide 345 kV terminals for the addition of the Unit 3 system connection at 345 kV and a 345 kV transmission line extension to Des Moines.

Transmission lines owned by IPS are shown in Exhibit II-A-2.


MINNESOTA
N
SPENCER
EMMETSBURG
CHARLES CITY
LE MARS
CHEROKEE
POCAHONTAS
CLARION
HAMPTON
ALLISON
STORM LAKE
SIOUX CITY
NEBRASKA
FORT DODGE
WATERLOO
IDA GROVE
SAC CITY
ROCKWELL CITY
MISSOURI RIVER
JOINTLY OWNED BY NEAL UNIT 3 OWNERS
CARROLL
SCRANTON
AUDUBON
LEGEND
34.5 AND 22 KV LINES
69 KV AND 46 KV LINES
161 KV LINE
345 KV LINE

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

THE EXISTING TRANSMISSION LINES OWNED BY IOWA PUBLIC SERVICE COMPANY

DATE:

SCALE:

EXHIBIT
II-A-2

B. THE PROPOSED PLANT

1. General

Neal Unit 4 will be located approximately 1 3/4 miles south of existing Units 1, 2 and 3 as shown in Exhibit II-B-1. This unit, having a net generating capacity of 576 MW, will consist of a steam generator designed to burn a variety of low sulfur western coals. This unit will consist of an indoor type, hydrogen cooled, 3600 revolutions per minute (rpm), tandem compound four-flow turbine generator designed to operate at 2400 pounds per square inch gauge (psig) and 1000°F with 1000°F reheat under throttle conditions. The steam generator will be capable of delivering 4,515,000 pounds of steam per hour continuously at 2630 psig and 1005°F at the superheater outlet.

The plant grade will be established at elevation 1076 feet. This elevation provides approximately 5 feet of freeboard above the U S Corps' of Engineers predicted one percent - 100 year flood elevation.* The plant river frontage is presently protected by riprap along its full length.

The Iowa Public Service Company is working with Rocky Mountain Energy Company, a subsidiary of the Union Pacific Corporation, on a plan for a joint venture to mine the primary coal for Neal Unit 4 from the Red Rim area in Sweetwater and Carbon Counties in Wyoming. A letter of intent has been signed by the parties and negotiations for a formal agreement are progressing. A subsidiary of Iowa Public Service Company will be the operating company. The subsidiary has already filed for the leases to the federal lands that adjoin lands owned by Rocky Mountain Energy Company.

The coal will be transported by unit trains on the Union Pacific Railroad which goes through the area. The Chicago Northwestern Railroad will take the unit trains from the Union Pacific Railroad at Council Bluffs, Iowa or Fremont, Nebraska and deliver them to the Neal Unit 4 site.

2. Circulating Water System

The Neal Unit 4 proposed water management flow diagram is presented in Exhibit II-B-2. As indicated, the unit will utilize a once-through circulating water system discharging into the Missouri River. Water will be withdrawn from a reinforced concrete intake structure located on the east bank of the Missouri River. Approximately 317,400 gpm of cooling water will be passed through the condenser to remove about 2.7 x 10^9 Btu/hr of waste heat and then discharged back to the river through a seal well located downsteam of the intake structure. The temperature rise of the Neal Unit 4 discharge will be about 17°F above the intake water temperature during plant operation at 100 percent capacity factor and approximately 14.5°F at an 65 percent daily average capacity factor. Exhibit II-B-3 presents a

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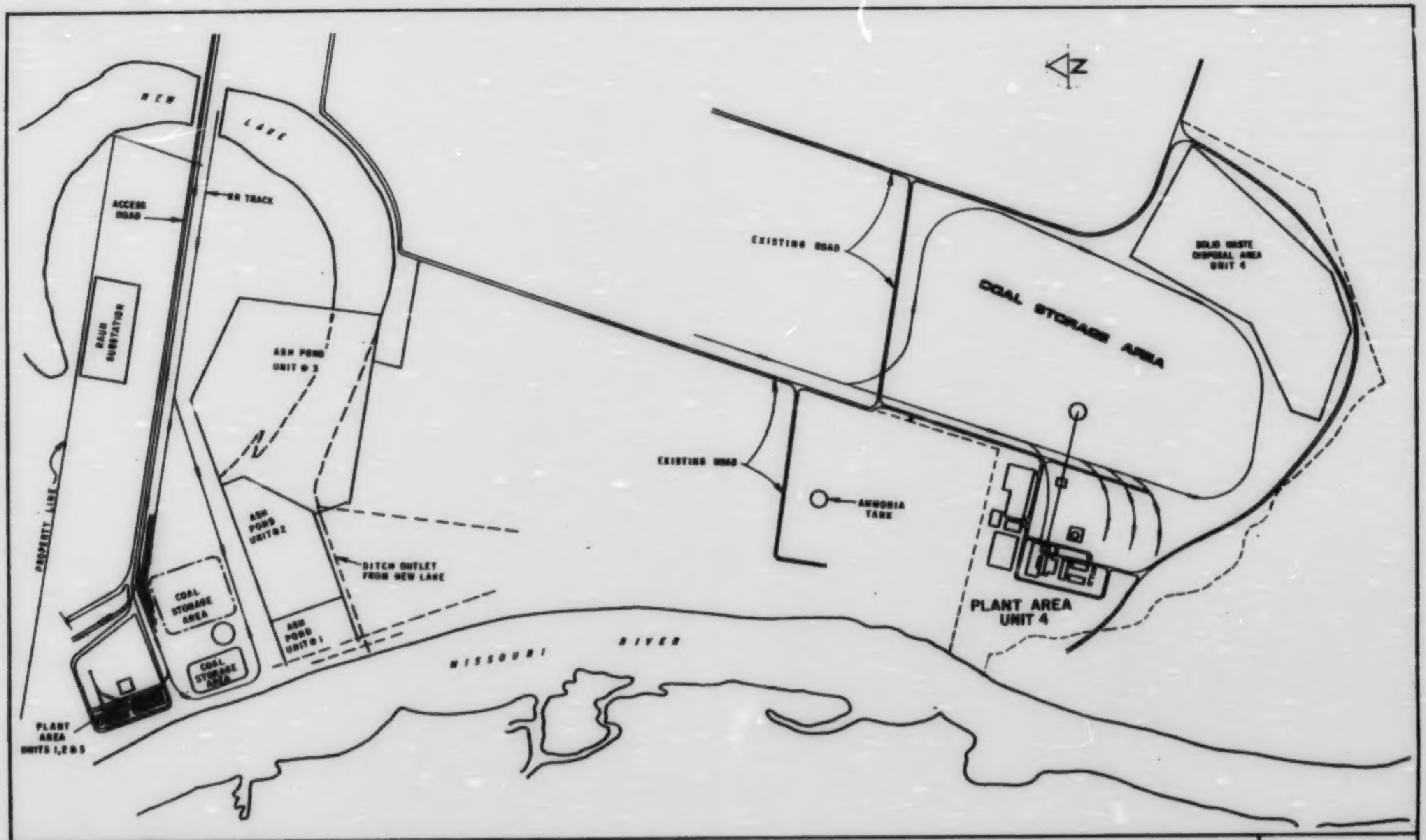
*Personal Communication - U.S. Army Corps of Engineers, Omaha District.


N
NEW LAKE
RR TRACK
ACCESS ROAD
RAUN SUBSTATION
PROPERTY LINE
ASH POND UNIT # 3
ASH POND UNIT # 2
ASH POND UNIT # 1
DITCH OUTLET FROM NEW LAKE
COAL STORAGE AREA
COAL STORAGE AREA
PLANT AREA UNITS 1, 2 & 3
MISSOURI RIVER
EXISTING ROAD
EXISTING ROAD
AMMONIA TANK
COAL STORAGE AREA
SOLID WASTE DISPOSAL AREA UNIT 4
PLANT AREA UNIT 4

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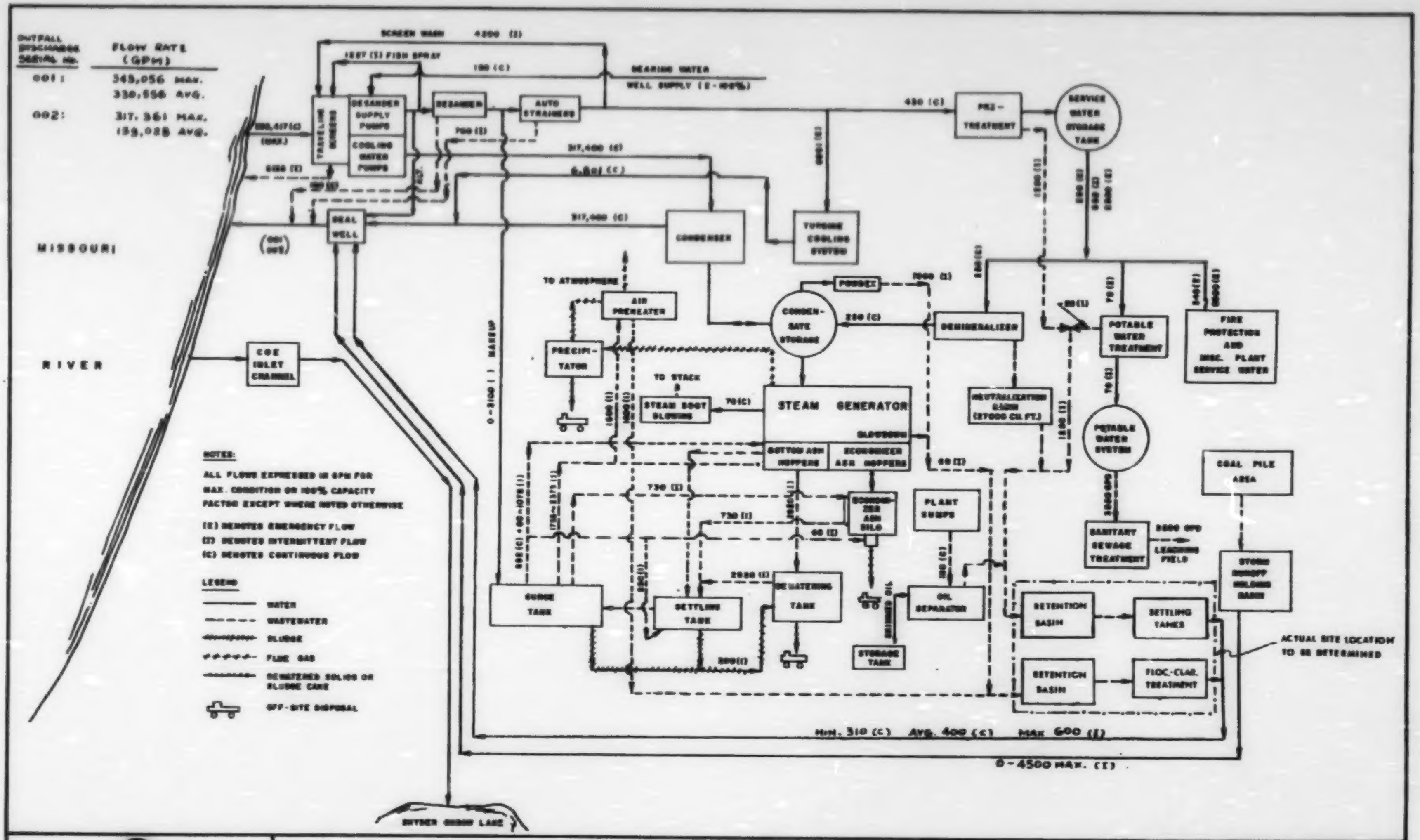
GEORGE NEAL STEAM ELECTRIC STATION, THE PROPOSED PLANT

DATE:

SCALE:

EXHIBIT
II-8-1


OUTFALL DISCHARGE SERIAL No.
FLOW RATE (GPM)
001: 343,056 MAX. 330,556 AVG.
002: 317,361 MAX. 159,028 AVG.
MISSOURI
RIVER
SCREEN WASH 4200 (I)
1227 (I) FISH SPRAY
190 (C)
BEARING WATER
WELL SUPPLY (I-100%)
TRAVELING SCREENS
DESANDER SUPPLY PUMPS
COOLING WATER PUMPS
DESANDER
AUTO STRAINERS
700 (I)
317,400 (C)
6,801 (C)
317,000 (C)
(MAX.)
SEAL WELL
(001) (002)
COE INLET CHANNEL
0-3100 ( ) MAKEUP
CONDENSER
TURBINE COOLING SYSTEM
430 (C)
PRE-TREATMENT
SERVICE WATER STORAGE TANK
TO ATMOSPHERE
AIR PREHEATER
PRECIPI-TATOR
TO STACK
STEAM SOOT BLOWING
70 (C)
POWDEX
7000 (I)
CONDEN-SATE STORAGE
250 (C)
DEMINERALIZER
NEUTRALIZATION BASIN (27000 CU. FT.)
STEAM GENERATOR
BLOWDOWN
BOTTOM ASH HOPPERS
ECONOMIZER ASH HOPPERS
60 (I)
730 (I)
730 (I)
ECONOMI-ZER ASH SILO
PLANT SUMPS
100 (C)
OIL SEPARATOR
SKIMMED OIL
STORAGE TANK
SURGE TANK
SETTLING TANK
2920 (I)
DEWATERING TANK
300 (I)
POTABLE WATER TREATMENT
70 (I)
POTABLE WATER SYSTEM
FIRE PROTECTION AND MISC. PLANT SERVICE WATER
SANITARY SEWAGE TREATMENT
LEACHING FIELD
COAL PILE AREA
STORM RUNOFF HOLDING BASIN
RETENTION BASIN
SETTLING TANKS
RETENTION BASIN
FLOC.-CLAR. TREATMENT
ACTUAL SITE LOCATION TO BE DETERMINED
MIN. 310 (C) AVG. 400 (C) MAX 600 (I)
0-4500 MAX. (I)
SNYDER OXBOW LAKE
NOTES:
ALL FLOWS EXPRESSED IN GPM FOR MAX. CONDITION OR 100% CAPACITY FACTOR EXCEPT WHERE NOTED OTHERWISE
(E) DENOTES EMERGENCY FLOW
(I) DENOTES INTERMITTENT FLOW
(C) DENOTES CONTINUOUS FLOW
LEGEND
WATER
WASTEWATER
SLUDGE
FLUE GAS
DEWATERED SOLIDS OR SLUDGE CAKE
OFF-SITE DISPOSAL

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IOWA PUBLIC SERVICE COMPANY – NEAL UNIT 4

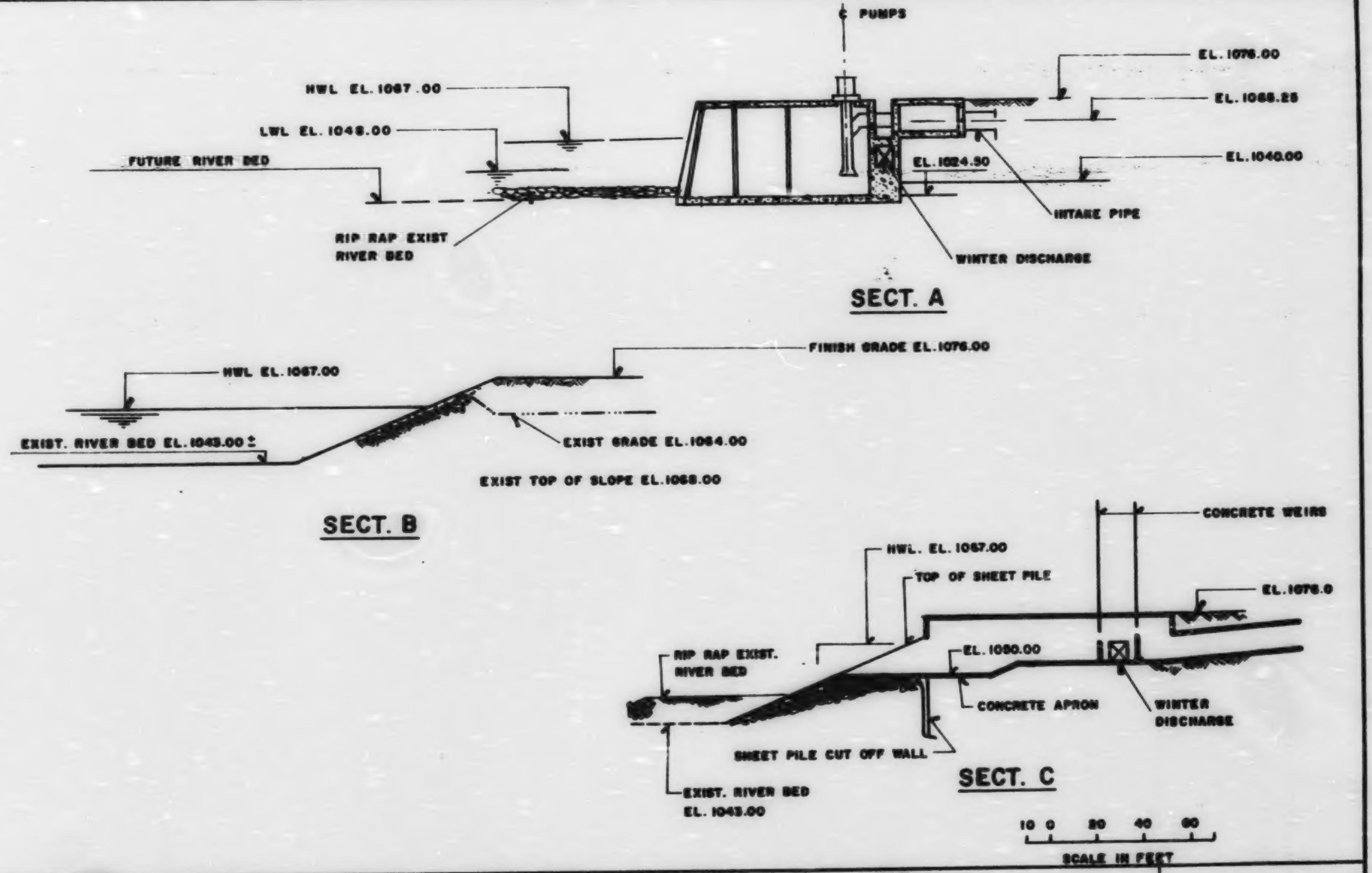
PROPOSED WATER MANAGEMENT FLOW DIAGRAM

DATE:

SCALE:

EXHIBIT

II-B-2



℄ PUMPS
HWL EL. 1067.00
LWL EL. 1048.00
FUTURE RIVER BED
RIP RAP EXIST RIVER BED
EL. 1076.00
EL. 1068.25
EL. 1040.00
EL. 1024.50
INTAKE PIPE
WINTER DISCHARGE
SECT. A
HWL EL. 1067.00
FINISH GRADE EL. 1076.00
EXIST. RIVER BED EL. 1043.00 ±
EXIST GRADE EL. 1064.00
EXIST TOP OF SLOPE EL. 1068.00
SECT. B
CONCRETE WEIRS
HWL. EL. 1067.00
TOP OF SHEET PILE
EL. 1076.0
RIP RAP EXIST. RIVER BED
EL. 1050.00
CONCRETE APRON
WINTER DISCHARGE
SHEET PILE CUT OFF WALL
EXIST. RIVER BED EL. 1043.00
SECT. C
10 0 20 40 60
SCALE IN FEET

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

SECTIONAL VIEWS OF THE UNIT 4 INTAKE AND DISCHARGE STRUCTURES

DATE:

EXHIBIT
II-B-3

schematic drawing of the proposed intake and discharge structure designs.

a. Intake Structure

The deck of the intake structure will be at an elevation of 1076 feet and the invert will be set at the projected future river bottom elevation of 1024.5 feet. Two vertical one-half capacity circulating water pumps will be provided in separate pump chambers with each chamber subdivided into three 11 foot 2 inch wide bays. Each bay will be provided with a trash rack, a two speed traveling screen and two guides which can be used either for stop logs or for fine screens. During normal plant operation, both circulating water pumps will be operated. The velocity through the six traveling screens will be about 0.9 fps with an approach velocity of about 0.4 fps at the design mean water elevation of 1055 feet (river flow - 12,000 cfs). During the navigational season which extends from April through November, the velocity through the traveling screens will be about 0.7 fps with an approach velocity of about 0.3 fps (river flow - 50,000 cfs).

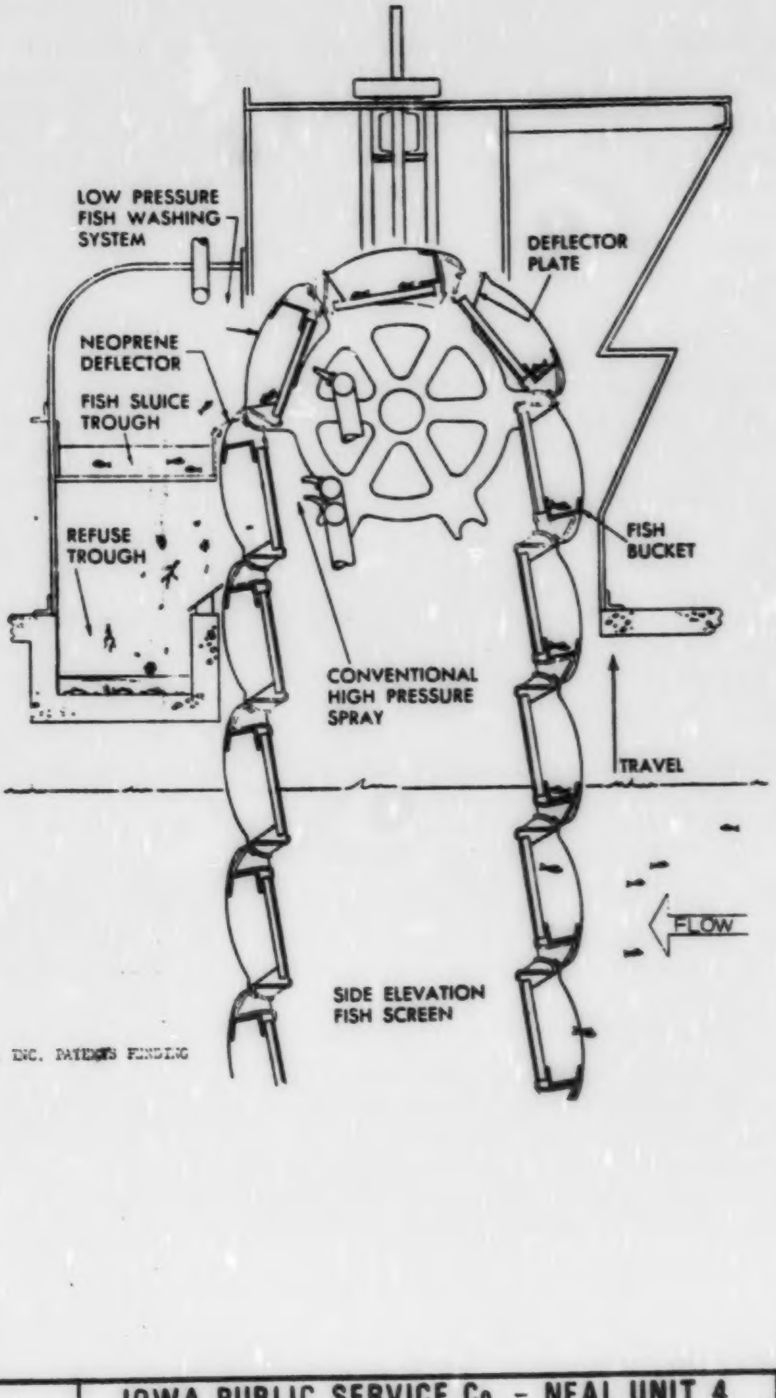
i. Traveling Screens

The traveling screens, as shown on Exhibit II-B-4, will be equipped with a fish protective system consisting of fish trays attached to each screen panel. Each panel will be subjected to low and high pressure water jet sprays to remove fish and debris, respectively. The system presented in Exhibit II-B-4 will be modified so that fish will be washed into a trough in front of the screens and will be sluiced to the river between the intake and discharge structures via a holding tank. Trash collected from the traveling screens will be returned to the river downstream of the intake structure via a separate debris trough. Logs and debris collected at the trash racks will be left in the river. The traveling screens will operate on an automatic pressure differential control. The traveling screens will be monitored and rotated periodically to prevent sand accumulation at the base of the screens. In addition, provisions will be made to allow for continuous operation of the traveling screens and spray system during periods of high fish entrapment.

ii. Desanding Units

Desander supply pumps will be located in the middle four bays of the intake structure. These pumps will supply water to the desanding system consisting of centrifugal sand separators that will serve to remove sand prior to pumping river water to the auxiliary cooling systems and other service water systems. This will prevent excessive abrasion of system pumps and heat exchanger tubing.

The sand slurry produced in the desanding process will be free of organics and will be directed to the circulating water


LOW PRESSURE FISH WASHING SYSTEM
DEFLECTOR PLATE
NEOPRENE DEFLECTOR
FISH SLUICE TROUGH
REFUSE TROUGH
FISH BUCKET
CONVENTIONAL HIGH PRESSURE SPRAY
TRAVEL
FLOW
SIDE ELEVATION FISH SCREEN

PERMISSION BY ENVIREX, INC. PATENTS PENDING

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

TRAVELING SCREEN WITH FISH
PROTECTION SYSTEM

EXHIBIT
II-B-4

DATE:
SCALE:

discharge for return to the river. Because the sand slurry will be diluted significantly, the resulting increase in sand concentration will be negligible.

b. Discharge Structure

The inlet section of the discharge structure will be a seal well consisting of a chamber of constant depth widening along its length and a weir at the downstream end. The outlet section of the discharge structure will consist of a large chamber with an overflow weir, stop logs and a regulating device for the winter discharge. Warm water from the winter discharge tunnel will be used to melt and/or deflect floating ice just upstream of the intake structure. The discharge channel will consist of sheet pile walls and a rip-rap bed.

3. Fuel Handling System

Sub-bituminous coal from the Red Rim area of Wyoming will be delivered to the site by unit train. The train will proceed to unloading hoppers where an automatic system will unload the entire unit train, consisting of about 10,000 tons of coal, in three to four hours. The coal will be transferred from the underground hoppers to the yard conveyor where a movable stacker/reclaimer will stack out the coal into two or more piles. Coal is reclaimed from the coal yard to the plant silos by the same system of overhead conveyors. The coal yard storage piles may be as high as 50 feet. A total dead storage of 800,000 tons and a live storage of 200,000 tons will occupy approximately 35 acres of the 450 acre site.

In order that coal handling and storage equipment emissions comply with EPA standards as set forth in 40 CFR 60 (maximum 20 percent opacity), all equipment, spouts, chutes, hoppers and conveyors will be enclosed by hoods, housings and casings to suppress dust. In addition, bag filter dust collectors will be installed at the reclaim pits and conveyor transfer points. A chemical spray dust suppression system will be utilized at the unloading hoppers to minimize fugitive dust emissions.

4. Air Quality Control System

Air quality control to comply with National Ambient Air Quality Standards and Federal New Stationary Source Performance Standards will be implemented at Neal Unit 4 through use of low sulfur coal, efficient combustion, a high efficiency electrostatic precipitator and an elevated release of combustion products into the atmosphere.

a. Fuel Characteristics

IPS has initiated a preliminary analysis, consisting of 30 test borings, in the Red Rim area. Characteristics of the coal from the area most likely to be used for Neal Unit 4 are presented on Table II-B-1. The complete results of the test boring analysis are presented in Appendix A-II-B.

The coal proposed for Neal Unit 4 will be low sulfur western coal with an average heating value of 9507 Btu/lb. At full capacity operation, the coal consumption rate will be approximately 780,000 lb/hour.

The average sulfur content of the coal will be approximately 0.32 percent which is sufficiently low so that complete oxidation of the coal sulfur to sulfur dioxide (SO2) would not cause Neal Unit 4 to violate the Federal New Stationary Source Performance Standard of 1.2 lb/mB of heat input.

The average ash content of the coal will be 8.22 percent. Particulate matter removal is required in order to meet the Federal New Stationary Source Performance of 0.1 lb/mB of heat input.

Characteristics of the typical western coal used in analyzing the impact of Neal Unit 4 are presented in Table II-B-2. Typical ash constitutents of this coal are presented in Table II-B-3. These data were utilized because the impact analysis was completed prior to the availability of the Red Rim coal analysis. The reduced environmental impacts associated with burning the improved quality Red Rim Area coal are discussed briefly in Chapter IV.

During the time the mine in the Red Rim area (see Exhibit II-B-5 and Table II-B-4) is being developed (2-5 years), Neal Unit 4 will utilize coal from the North Knobs area which is situated a few miles to the north. This section is privately owned and will be surface mined under a mining permit from the State of Wyoming. Test borings will be performed in this area during the summer of 1976 to determine the coal characteristics. Preliminary indications are that the coal is similar to that of the Red Rim area. Trace elements found in coal samples from the North Knobs area are presented in Table II-B-5 and trace element concentrations in typical western coal, representative of the principal and interim coal supply, are provided in Table II-B-6.

b. Combustion Reaction

The coal will be pulverized prior to firing to obtain thorough and intimate mixing of fuel and air. The amount of air consumed in the furnace during combustion will be 20 percent above the stoichiometric air-to-fuel ratio, resulting in maximum combustion efficiency and minimum production of unburned hydrocarbons, carbon monoxide and soot. Production of nitrogen oxides (NOx), however, normally increases as peak combustion efficiency is reached. The control of NOx production is based on reduction of combustion flame temperature and control of the amount and distribution of excess air in the combustion zone.

Drill Hole	HHV (Btu/lb)	Sulfur (%)	Moisture (%)	Ash (%)
Seam (F2)				
128	9,970	0.2	16.54	5.68
134	9,607	0.24	16.57	7.18
136	9,327	0.37	17.71	7.65
Seam (F1)				
15	8,251	0.52	20.44	13.94
125	9,345	0.32	16.01	11.12
128	9,786	0.15	15.97	6.77
132	9,652	0.21	15.74	7.15
135	9,429	0.27	16.55	8.86
Seam (G)				
4	9,465	0.32	16.17	10.29
128	10,046	0.57	16.07	5.84
137	9,706	0.3	17.39	5.96
AVG	9,507	0.32	16.83	8.22
MAX	10,046	0.57	20.44	13.94
MIN	8,251	0.15	15.74	5.68

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

CHARACTERISTICS OF WESTERN COAL
TO BE USED AT NEAL UNIT 4

DATE: SCALE:

TABLE
II-B-1

Fuel Constituents	Percent by Weight
Proximate Analysis	**Typical**
Volatile Matter	32.6
Fixed Carbon	31.6
Ash	5.8
Moisture	30.0
Totals	100.00

Fuel Constituents	Percent by Weight
Ultimate Analysis	Typical
Carbon	48.5
Hydrogen	3.4
Sulfur	0.4
Oxygen	11.2
Nitrogen	0.7
Ash	5.8
Moisture	30.0
Totals	100.00

High Heat Value - Btu/lb (as Fired)	8.125

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

CHARACTERISTICS OF TYPICAL WESTERN COAL

TABLE
II-B-2

DATE: SCALE:

Ash Constituents	Typical (Percent)
Ferric Oxide – Fe_2O_3	4.1
Lime – CaO	25.0
Magnesia – MgO	4.2
Sodium – Na_2O	1.5
Potassium – K_2	0.5
Silica – SiO_2	31.4
Alumina – Al_2O_3	16.2
Titanium – TiO_2	1.1
Sulfur – SO_3	14.8
Phosphorus – P_2O_5	1.1
Undetermined	0.1

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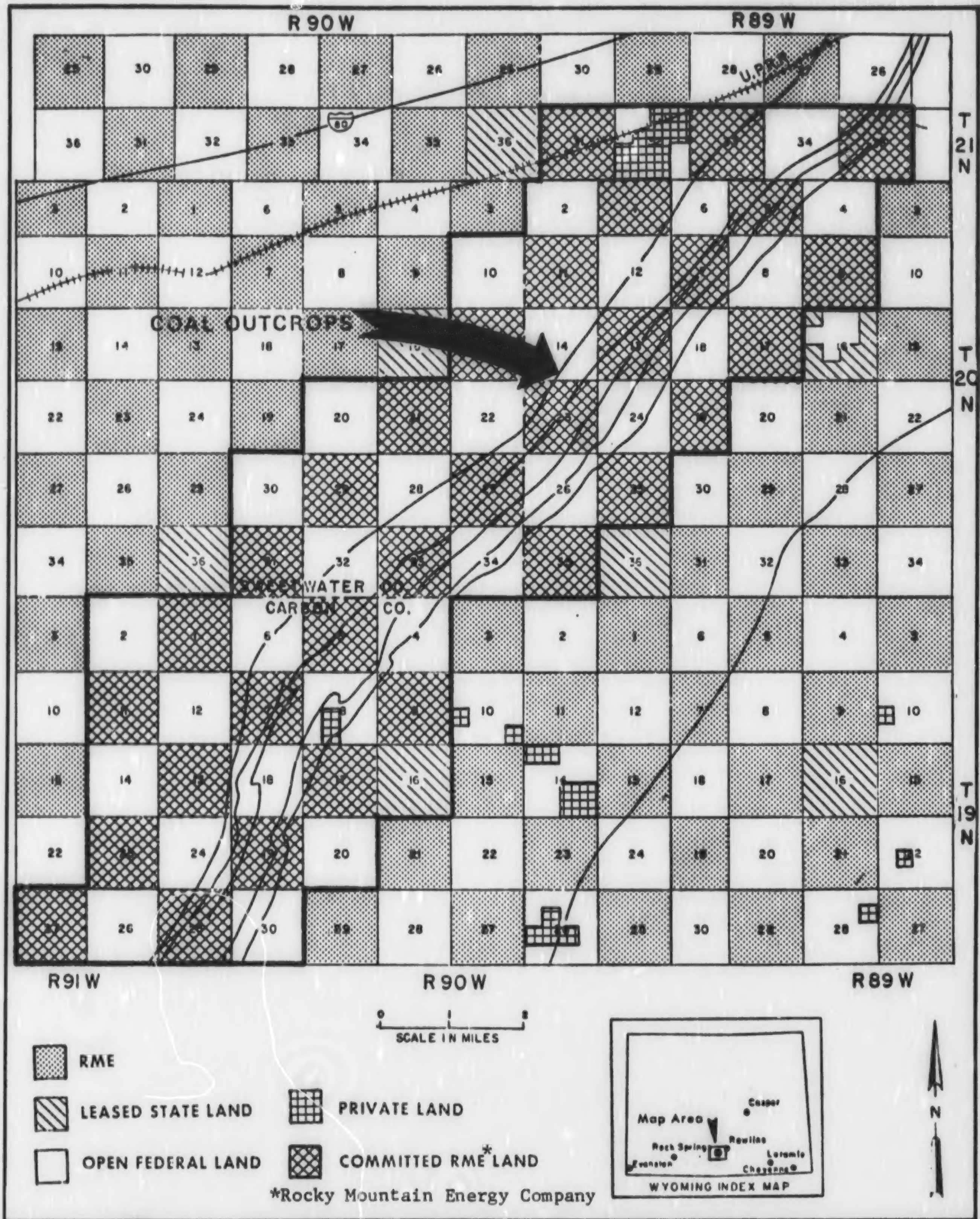
IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

ASH CONSTITUENTS OF TYPICAL WESTERN COAL

TABLE
II-B-3

DATE:

SCALE:


R 90 W
R 89 W
T 21 N
T 20 N
T 19 N
U.P.R.R.
80
COAL OUTCROPS
SWEETWATER CO.
CARBON CO.
R91 W
R 90 W
R 89 W
0 1 2
SCALE IN MILES
RME
LEASED STATE LAND
OPEN FEDERAL LAND
PRIVATE LAND
COMMITTED RME* LAND
*Rocky Mountain Energy Company
Map Area
Casper
Rock Springs
Rawlins
Evanston
Laramie
Cheyenne
WYOMING INDEX MAP
N

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

COAL AREA OWNERSHIP

DATE: SCALE:

EXHIBIT
II-B- 5

COAL SUPPLY LOCATION DESCRIPTION

ROCK SPRINGS ROYALTY COMPANY - ENERGY DEVELOPMENT CO.
Agreement and Option - Subject Lands
Lease Agreement - Leased Premises

Township 22 North, Range 89 West, 6th P.M.

Section 35: All

Township 21 North, Range 89 West, 6th P.M.

Section 1: All
Section 3: All
Section 11: All
Section 13: All, except that portion of the South Half (S½) of Section 13, Township 21 North, Range 89 West, 6th P.M., Wyoming, described by metes and bounds as follows:

Beginning at the southwest corner of said Section 13;
thence N. 45°22' E. a distance of 508.82 feet;
thence N. 81°26' E. a distance of 1056.18 feet;
thence S. 8°34' E. a distance of 10.0 feet;
thence N. 81°26' E. a distance of 500.0 feet;
thence N. 8°34' W. a distance of 10.0 feet;
thence N. 81°26' E. a distance of 3346.97 feet to the point of beginning of a curve to the rigth the radius of which is 11309.2 feet;

thence along said curve to the right through a central angle of 0°17' a distance of 55.3 feet, more or less, to a point on the east boundary of said Section 13, from which the southeast corner thereof bears S. 0° 01' E. a distance of 1110.56 feet;

thence N. 0° 01' W. along the east boundary of said Section 13 a distance of 942.44 feet to a point, from which the east quarter corner of said Section 13 bears N. 0° 01' W. a distance of 576.8 feet, said point being on a curve to the left the radius of which is 7739.47 feet and at which point a line tangent to said curve bears S. 85° 35' W.;

thence along sais curve to the left through a central angle of 12° 23' a distance of 1673.71 feet;
thence S. 73°12' W. a distance of 3271.1 feet;
thence N. 10°48' W. a distance of 150 feet;
thence S. 84°05' W. a distance of 470 feet; more or less, to a point on the west boundary of said Section 13, from which the west quarter corner thereof bears N. 0° 11' W. a distance of 1741.07 feet;

thence S. 0° 11' E. along the west boundary of said Section 13 a distance of 894 feet, more or less, to the place of beginning;

said parcel of land containing 89.7 acres, more or less,

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IOWA PUBLIC SERVICE CO. - NEAL UNIT 4

COAL SUPPLY LOCATION DESCRIPTION

DATE:

TABLE
II-B-4

TABLE II-B-4 (Cont'd)

Section 23: All, except that portion of the North Half (N½) of the North Half (N½) of Section 23, Township 21 North, Range 89 West, 6th P.M., Wyoming, described by metes and bounds as follows:

Beginning at the northeast corner of said Section 23;

thence S. 89° 30' W. along the north boundary of said Section 23 a distance of 2623.1 feet, more or less, to the north quarter corner of said Section 23;

thence westerly along the north boundary of said Section 23 a distance of 86.92 feet;

thence S. 73° 12' W. a distance of 2660.01 feet; more or less, to a point on the west boundary of said Section 23, from which the northwest corner thereof bears N. 0° 05' W. a distance of 747.31 feet;

thence S. 0° 05' E. along the west boundary of said Section 23 a distance of 365.44 feet, from which point the west quarter corner of said Section 23 bears S.0° 05' E. a distance of 1535.25 feet;

thence N. 73° 12' E. a distance of 3386.36 feet;

thence N. 74° 48' E. a distance of 638.83 feet, more or less, to a point on the north boundary of said Section 23, from which the northeast of 1399.55 feet; bears N. 89° 30' E. a distance of 1399.55 feet;

thence S. 16° 48' E. a distance of 100 feet;

thence N. 85° 30' E. a distance of 1374.84 feet, more or less, to the place of beginning;

said parcel of land containing 28.4 acres, more or less.

Section 25: All
Section 27: All

ELEMENT	ANALYSIS OF ASH	ANALYSIS OF WHOLE COAL
Arsenic	nd*	nd
Barium	2,840	270
Cadmium	nd	nd
Chromium	160	15
Copper	60	6
Lead	20	2
Zinc	105	10
Uranium	10.7	1.13
Mercury	volitalized upon ashing	.15
Selenium		.5
Antimony		nd
Thorium		nd
Flourine		80
Cyanide	no possible way to test	

*Not Detected

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

TRACE ELEMENTS FOUND IN COAL SAMPLES
NORTH KNOBS AREA, WYOMING (ppm)

DATE: SCALE:

TABLE
II-B-5

Trace Element	Montana Peabody Coal Co. Big Sky Mine (as received)	Montana Western Energy Co. Rosebud Mine (as received)
Antimony	7.5 (none detected)	
Arsenic	0.3	Trace
Barium	210	
Beryllium	0.03 (none detected)	Trace
Boron	34.5	Trace
Bromine	7.5 (none detected)	15.8
Cadmium	5.3 (none detected)	0.17
Chlorine	73.5	124
Chromium	9	2.2
Cobalt	3.5	0.33
Copper	9.8	75
Europium		0.06
Fluorine	3.8	33.7[a]
Galluim	6.5	
Germanium	3 (non detected)	
Hafnium		0.59
Lanthanum		2.9
Lead	16.5	3.61
Lithium	10.5	
Manganese	48	71
Mercury	0.46	0.16[b]
Molybdenum	24	
Nickel	5.3	
Samarium		0.40
Scandium		0.75
Selenuim	0.4	0.012
Strontium	185	
Tantalum		0.19
Terbium		0.046
Thalluim		1.1
Tin	4.5 (trace amount)	
Vanadium	1.5 (none detected)	4.1
Zinc	20.5	
Zirconium	25.5	

[a] a/ Two standard deviations above the mean value.

[b] b/ Maximum reported value.

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IOWA PUBLIC SERVICE CO. - NEAL UNIT 4

AVERAGE CONCENTRATIONS OF TRACE ELEMENTS
IN TYPICAL WESTERN COAL (ppm)

DATE: SCALE:

TABLE
II-B-6

The Neal Unit 4 furnace will utilize interstage air ports and off-stoichiometric firing to achieve these goals.

The incombustible heavier particles, mainly bottom ash, resulting from coal combustion will settle out of the firebox into bottom ash hoppers. Under optimum conditions, much of the finer particles, consisting mainly of airborne fly ash and soot, will be collected by the electrostatic precipitator (discussed in next section).

c. Electrostatic Precipitator

The electrostatic precipitator for Neal Unit 4 will be a hot side precipitator with a guaranteed particulate removal efficiency of 99.6 percent when utilizing coal with a sulfur content range of 0.3 to 0.7 percent and an ash content range of 3 to 18 percent. The maximum flue gas flow rate will be about 4,200,000 Actual Cubic Feet Per Minute (ACFM). The precipitator will be designed to handle loads up to 117,000 pounds of particulate matter per hour. Based on a maximum fly ash content of 18 percent, the maximum particulate emission rate will be 0.05 lb/mB which is within the Federal New Stationary Source Performance Standard of 0.1 lb/mB.

A schematic of the precipitator for Unit 4 is shown in Exhibit II-B-6.

d. Boiler Stack

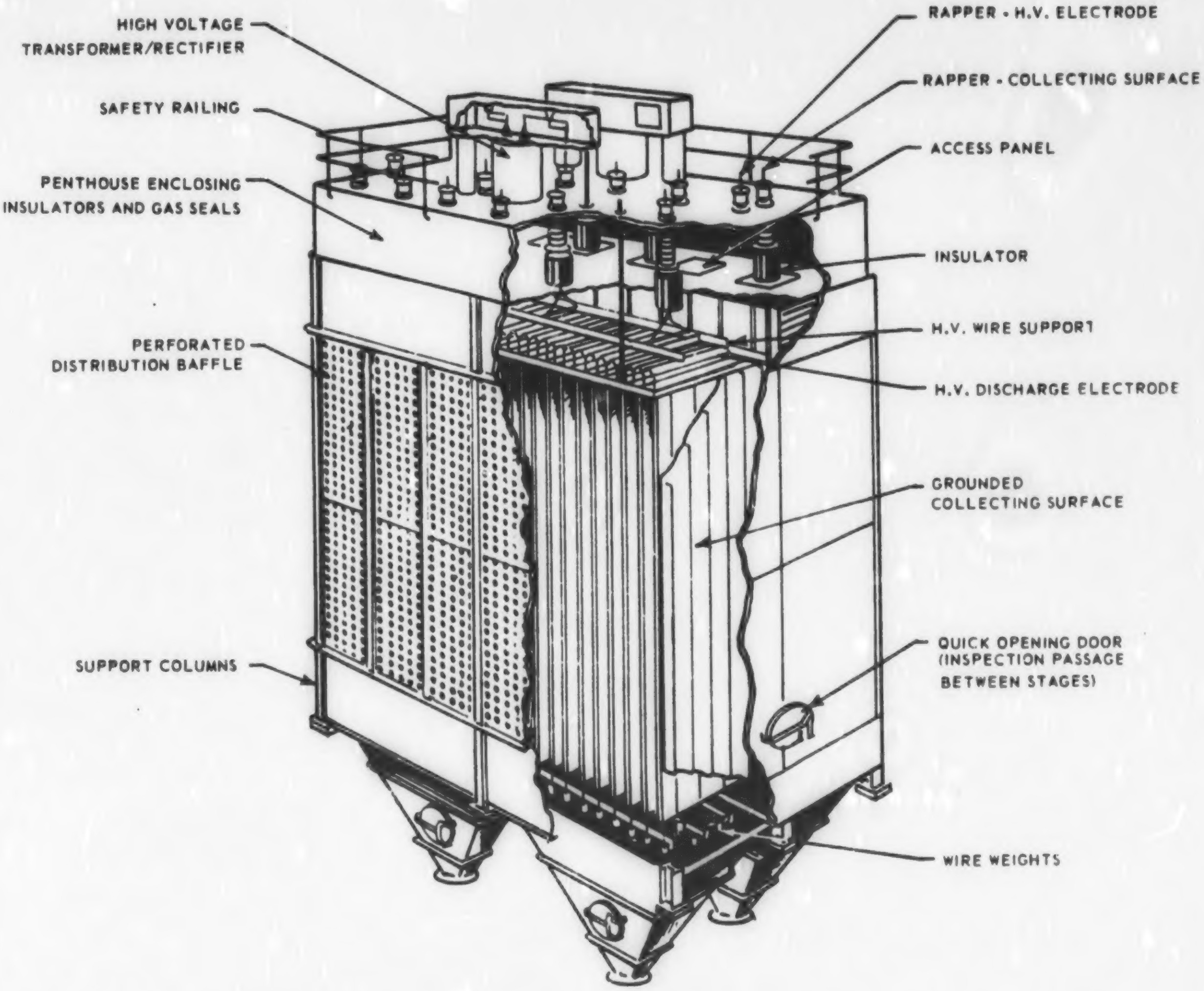
As stated previously, the use of 0.32 percent (average) sulfur coal will ensure Neal Unit 4 compliance with Iowa and federal emission standards for SO2. The National Ambient Air Quality Standards for SO2 and the other emitted pollutants will be met by releasing the gaseous pollutants at elevations where atmospheric winds will normally disperse and diffuse the pollutants before they reach ground level.

The boiler stack on Neal Unit 4 will result in the elevated release of gaseous pollutants. It will have a height of 469 feet and a top outlet diameter of 25.75 feet. As the gas exits the stack it will have a velocity of 90 fps and a temperature of 244°F which will give the stack plume additional buoyancy.

The UTM coordinates for the Unit 4 boiler stack will be as follows:

Latitude	Longitude
42° - 18' - 08"N	96° - 21' - 44"W

Table II-B-7 presents the maximum emission rates calculated for the gaseous and solid combustion products for the major pollutants leaving the stack. Pollutant concentrations as the plume diffuses and drifts to ground level are dealt with in


HIGH VOLTAGE TRANSFORMER/RECTIFIER
SAFETY RAILING
PENTHOUSE ENCLOSING INSULATORS AND GAS SEALS
PERFORATED DISTRIBUTION BAFFLE
SUPPORT COLUMNS
RAPPER - H.V. ELECTRODE
RAPPER - COLLECTING SURFACE
ACCESS PANEL
INSULATOR
H.V. WIRE SUPPORT
H.V. DISCHARGE ELECTRODE
GROUNDED COLLECTING SURFACE
QUICK OPENING DOOR (INSPECTION PASSAGE BETWEEN STAGES)
WIRE WEIGHTS

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

CUTAWAY VIEW OF TYPICAL

ELECTROSTATIC PRECIPITATOR

DATE: SCALE:

EXHIBIT
II-B-6

	Unit 4	Total Station
Emissions (lb/hr) [a]		
Sulfur Dioxide	7,090 [a]	26,260
Nitrogen Oxides	4,140[b]	12,700
Particulates	420[d]	1,260
Emissions		
Nitrogen Vol (%)	71.8	71.8
Oxygen Vol (%)	4.2	4.2
Water Vapor Vol (%)	11.6	11.6
Carbon Dioxide Vol (%)	12.3	12.3
Total Flue Gas (ACFM)	1,750,000	5,010,000
Sulfur Dioxide (lb/mB)[c]	1.2	
Nitrogen Dioxide (lb/mB)[b]	0.7	
Particulates (lb/mB)[d]	0.07	

[a] Coal at 8125 Btu/Lb for Unit 4

[b] Based on Federal New Stationary Source Performance Standards

[c] For 0.49% Sulfur coal with fuel sulfur as SO_2

[d] 20% of coal ash as furnace bottom ash, 99.6% efficient electrostatic precipitator. Maximum fly ash content of 18%.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

MAXIMUM EMISSIONS CALCULATED FOR
NEAL UNIT 4 AND TOTAL STATION
AT FULL CAPACITY OPERATION

DATE: SCALE:

TABLE
II-B-7

Section IV-C. This information is based on the typical coal characteristics utilized prior to the Red Rim area analysis.

5. Water Pretreatment System

Desanded river water will be pumped from the intake structure to the water pretreatment plant for potable water usage, boiler feedwater, fire protection, and other miscellaneous plant systems. The water pretreatment system, consisting of two upflow sand filters, will utilize the processes of chemical coagulation and filtration for the removal of suspended and colloidal solids. Each filter will be designed to treat a flow of 400 gpm.

A polymer approved by the U.S. EPA for drinking water use will be added as a coagulant to improve filtration efficiency. The sand filters will require periodic backwashing. The frequency of backwashing will be dependent upon the concentration of suspended solids in the filter influent. To insure a continuous supply of filtered water, pretreated water will be retained in the service water storage tank.

6. Demineralizer System

Boiler feedwater is the highest quality water required for plant operation and must be free of suspended and dissolved solids prior to use. Boiler makeup water for Neal Unit 4 will be drawn from the service water storage tank and passed through the following demineralization equipment:

- stratabed cation exchanger
- degasifier (for CO2 removal)
- organic scavenger
- stratabed anion exchanger
- mixed bed cation-anion exchanger (polishing unit)

The demineralized water will be stored in the condensate storage tank for use in the steam cycle.

7. Potable Water System

The potable water system will be designed to serve approximately 100 plant personnel. Water from the pretreatment plant will be passed through an activated carbon filter and then chlorinated to insure that drinking water standards will be met. An average demand of 4.5 gpm is anticipated for this system. It should be noted, however, that consumption will probably occur in surges concurrent with working shift changes.

8. Wastewater Characterization

The wastewater discharged from various plant areas can be classified into three general categories: high-volume water from main condenser cooling and auxiliary cooling systems; low-volume wastewater resulting from operation and maintenance of various process units; and storm water runoff from material storage areas. The low-volume wastewater discharges contain high suspended and/or dissolved solids; acidity or alkalinity; oil and grease; heavy metals; etc. These discharges will be treated to comply with applicable Iowa, Nebraska and federal NPDES regulations.

a. Main Condenser Cooling Water Discharge

A once-through cooling system will be employed to remove waste heat from the steam cycle. A total flow of 317,400 gpm will be discharged through a seal well directly into the Missouri River. The abrasive action of the sand, entrained in the river water, will remove any accumulated biological slime. Therefore, chemicals for the control of biological fouling will not be added to the cooling water system. The cooling water discharge will have essentially the same chemical composition as the river water.

b. Auxiliary Cooling Water

The cooling water discharged from auxiliary heat exchangers and coolers will be discharged into the Missouri River through the seal well. Total flow from the system will be 6,801 gpm.

Periodically, raw river water may be passed through these cooling units so that the abrasive action of the river's suspended solids may remove any accumulated biological slimes. No chemical biocides will be added in the auxiliary cooling water.

c. Demineralizer Regeneration Wastewater

It is anticipated that the demineralizer will be regenerated twice per day. The maximum daily quantity of regenerated wastewater produced will be approximately 152,000 gallons including spent chemicals and rinse water. The wastewater will be discharged to a neutralization tank and then bled to the treatment plant at a continuous rate of 150 gpm.

The spent regenerant solution will contain eluted ions with excess acid and/or caustic soda. The eluted cations will include calcium, magnesium, potassium, and sodium, and the eluted anions will include sulfate, chloride, nitrate, phosphate, bicarbonate, carbonate, and hydroxide. The total dissolved solids concentration will range between 5,000 and 10,000 mg/l.

d. Water Pretreatment and Potable Water Treatment Wastes

The sand filter used for water pretreatment will be backwashed periodically to remove the accumulated suspended solids from the filter bed. The backwash water flow is estimated to be 1,200 gpm for a duration of 10-20 minutes depending on the suspended solids concentration in raw water. The backwash frequency will also depend on the total suspended solids concentration in the filter influent.

The suspended solids in the filter backwash wastewater will be high (over 3,000 mg/l) at the beginning of the backwashing cycle and will gradually decrease as the cycle progresses. The average suspended solids concentration will be approximately 900 mg/l.

The wastewater discharged from the potable water treatment unit's carbon filter, will be relatively low in both suspended solids concentration and volumetric flow rate. The carbon filter backwashing frequency will depend upon the concentrations of total suspended solids and dissolved organic material. After carbon filter backwashing, steam will be passed through the column to strip it of adsorbed organic compounds and restore the adsorptive property of the column.

e. Boiler Blowdown And Boiler Draindown

The boiler blowdown flow is estimated to be 60 gpm. This waste stream will be high in temperature and will contain suspended solids.

The flow discharged from the boiler draindown system will be approximately 1500 gpm. The wastewater will be relatively high in temperature, suspended solids, iron (Fe) and possibly copper (Cu).

f. Boiler Cleaning Wastes

The internal heating surfaces of the boiler are cleaned at infrequent intervals, from 36 to 60 months. Intervals between cleanings are extended or reduced as conditions warrant. The quantity and quality of the wastewater is dependent upon the method used for boiler cleaning.

Chemical cleaning agents are usually employed to remove scale and corrosion products from the boiler tubes. The cleaning solutions commonly used are: hydroxyacetic-formic acid, ammoniated citric acid, hydrochloric acid, alkaline chelating chemicals, and other organic solvents such as "Vertan 675".

The major contaminants in the cleaning wastes will be total suspended solids, total dissolved solids, iron, copper, oil and grease.

The total volume of wastewater generated during a full cycle cleaning of the Unit 4 boiler is estimated to be 730,000 gallons, including cleaning solution and rinse water.

g. Powdex Backwash

Periodic backwashing of the powdex unit, which will maintain high water quality in the boiler feed cycle, will be performed to remove spent resin. Backwash flow is estimated to be 1,060 gpm.

h. Air Preheater Cleaning Wastes

Air preheaters are usually cleaned by washing down soot and fly ash accumulation on the surfaces with high-pressure water jets. Therefore, the washing wastewater will contain fly ash, soot, rust, oil and grease, and metallic ions. Depending upon the sulfur content of the coal, the cleaning wastes are more or less acidic in nature.

The cleaning frequency is determined by the accumulated time under oil-fired startup operation. Usually, cleaning is necessary after 72 hours of operation on oil. The total volume of wastewater resulting from air preheater cleaning is estimated to be 192,000 gallons, i.e., 1,600 gpm of flow rate for two hours duration for each train of two air preheaters.

i. Plant Floor Drains and Miscellaneous Wastewaters

This wastewater category represents routine discharge from floor drains, including miscellaneous equipment cleaning wastes. The flow rate and the level of contamination will be highly dependent upon plant maintenance operations. All mechanical equipment will require periodic lubrication and they are, therefore, potential sources of oily wastes. Additional pollutants will be suspended solids that may be washed into floor drains. The average waste flow rate from this source is estimated to be 100 gpm.

j. Ash Systems Emergency Discharge

The fly ash, collected using electrostatic precipitators, will be conveyed pneumatically to fly ash silos, from which the ash will be removed by truck for disposal. The bottom ash will be hydraulically transported from the bottom ash hoppers to a dewatering tank. The dewatered bottom ash will be trucked away along with fly ash for disposal. Clarified effluent will be recirculated to the bottom ash sluicing system. Therefore, there will be no wastewater discharges from the ash handling and sluicing systems during normal plant operating conditions. However, in case of the failure of the jet exhauster at the economizer ash silo, there will be an emergency discharge from the bottom ash sluicing system to the fly ash disposal site. The ash transport water system flow diagram is presented in Exhibit II-B-7.

k. Sanitary Wastewater

Sanitary wastewater is characterized by high BOD, suspended solids and fecal coliform counts. All sanitary waste streams from locker rooms, showers and toilets will be collected and piped to the sanitary sewage treatment facility. During plant operation, it is estimated that a staff of 100 persons will be stationed at the plant over any 24-hour period. Based on a flow of 35 gallons per capita per day, the sanitary wastewater produced will be 3,500 gallons per day (gpd). Typical water quality characteristics of the sanitary wastes, exclusive of coliform bacteria, are expected as follows:

BOD5	180 mg/l
Suspended Solids	200 mg/l
Settleable Solids	60 ml/l

l. Coal Pile Runoff

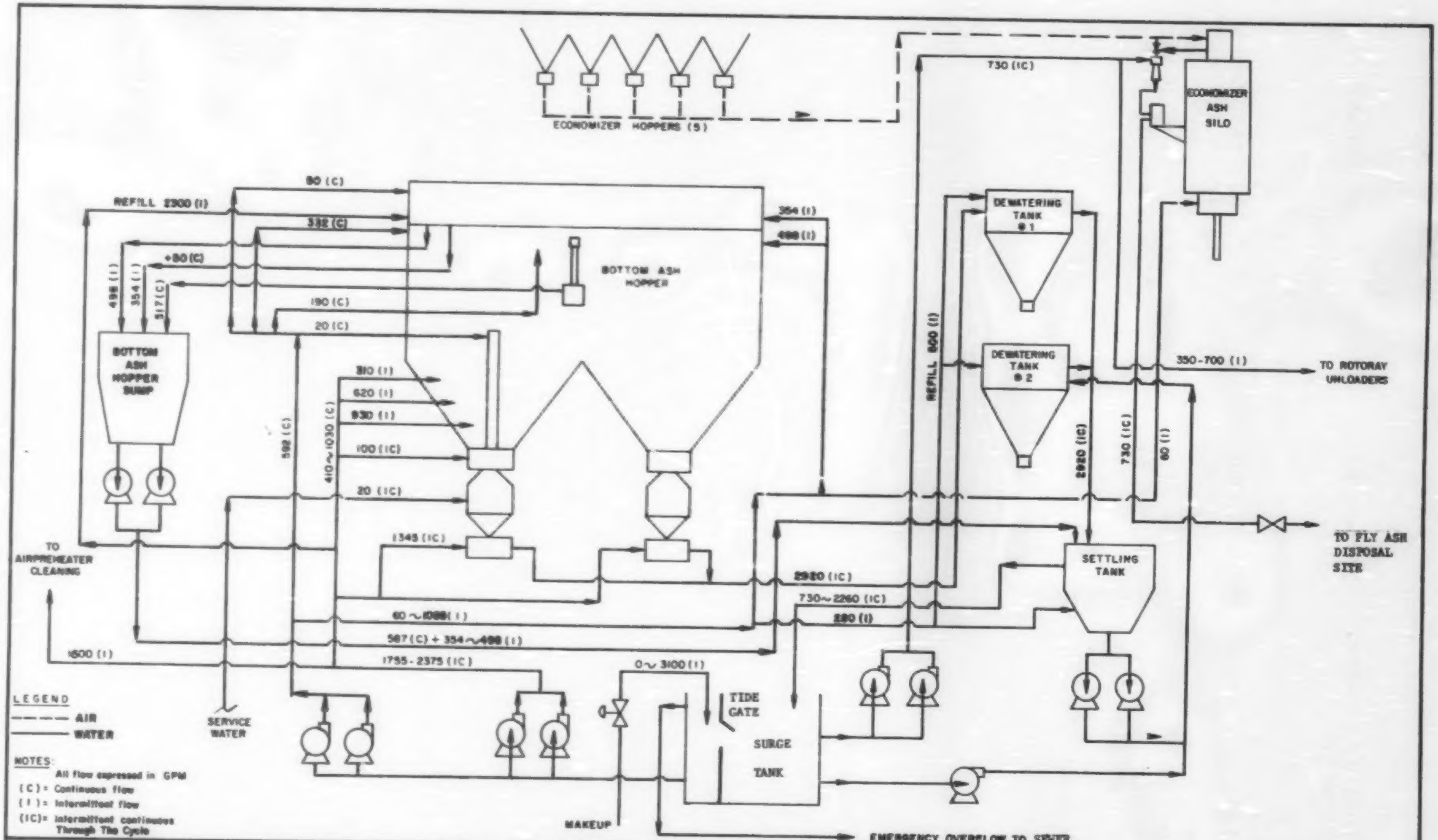
Coal pile runoff is characterized by high suspended solids. The pH of coal pile runoff will partially depend upon the sulfur content of the coal. In general, low sulfur coal will have a high calcium content resulting in a high pH of any runoff water entering the holding basin. This is supported by field data obtained from studies at Neal Unit 3 indicating pH values of 7-9. The suspended solids result from coal handling operations which tend to generate many fine particulates through abrasion.

The total volume of runoff will be dependent upon the rainfall duration and intensity, antecedent rainfall characteristics, and physical conditions at the coal pile area. The total volume to be handled is estimated to be 6.51 mgd based on a 10-year 24-hour rainfall event (5.0 inches) and a total catchment area of 48 acres.

9. Wastewater Treatment Systems

Based on water quality characteristics, the plant wastewater flows can be segregated into five different categories. These are as follows:

- Acid wastes (demineralizer regenerant wastes) requiring pH adjustment pretreatment.
- Oily wastes (plant floor drainage) requiring oil-water separation pretreatment.
- Non-metal contaminated wastes (filter backwash, plant drainage, etc) requiring sedimentation for suspended solids removal.


ECONOMIZER HOPPERS (5)
ECONOMIZER ASH SILO
730 (IC)
80 (C)
REFILL 2300 (I)
332 (C)
+80 (C)
498 (I)
354 (I)
517 (C)
190 (C)
20 (C)
354 (I)
498 (I)
BOTTOM ASH HOPPER
BOTTOM ASH HOPPER SUMP
310 (I)
620 (I)
930 (I)
100 (IC)
20 (IC)
592 (C)
410~1030 (C)
1345 (IC)
60~1088 (I)
587 (C) + 354~498 (I)
1755 - 2375 (IC)
1600 (I)
0~3100 (I)
TO AIRPREHEATER CLEANING
SERVICE WATER
MAKEUP
TIDE GATE
SURGE TANK
EMERGENCY OVERFLOW TO SEWER
DEWATERING TANK #1
DEWATERING TANK #2
REFILL 800 (I)
2920 (IC)
2920 (IC)
730~2260 (IC)
280 (I)
730 (IC)
60 (I)
350-700 (I)
TO ROTORAY UNLOADERS
SETTLING TANK
TO FLY ASH DISPOSAL SITE
LEGEND
AIR
WATER

NOTES:

All flow expressed in GPM

(C) = Continuous flow

(I) = Intermittent flow

(IC) = Intermittent continuous Through The Cycle

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

NEAL 4 BOTTOM ASH & ECONOMIZER ASH RECIRCULATING SYSTEM

DATE:

SCALE:

EXHIBIT

II-B-7

- Metal contaminated wastes (boiler cleaning and drain down flows, air preheater cleaning wash, powdex backwash, and boiler blowdown) requiring physicochemical treatment for suspended solids, iron and copper removal.

- Sanitary wastewater requiring biological treatment for suspended solids and BOD removal.

The proposed wastewater treatment block flow diagram is presented in Exhibit II-B-8. The estimated flow rate for each waste stream and its associated treatment process unit capacity are presented in Table II-B-8.

As indicated in Exhibit II-B-8, three retention ponds are proposed to provide flexibility in the collection, equalization and treatment of plant wastewaters.

Pond A will be sized to contain the entire volume of Unit 4 boiler cleaning wastes which is estimated at 750,000 gallons. A private contractor will provide a temporary pipeline for drainage of the cleaning wastes from the boiler to the pond and also will remove the cleaning wastes for disposal off-site.

Pond B will be sized at 300,000 gallons to accomplish equalization of the intermittent and high flow rate wastewaters for the downstream physicochemical treatment units. The pond will be operated in a filling-empty cycle mode to accomodate either boiler draindown or air preheated cleaning wastewater. Average pond discharge will be 100 gpm, for the daily average inflow, and a maximum flow of 200 gpm will be pumped when the pond receives cleaning wastes.

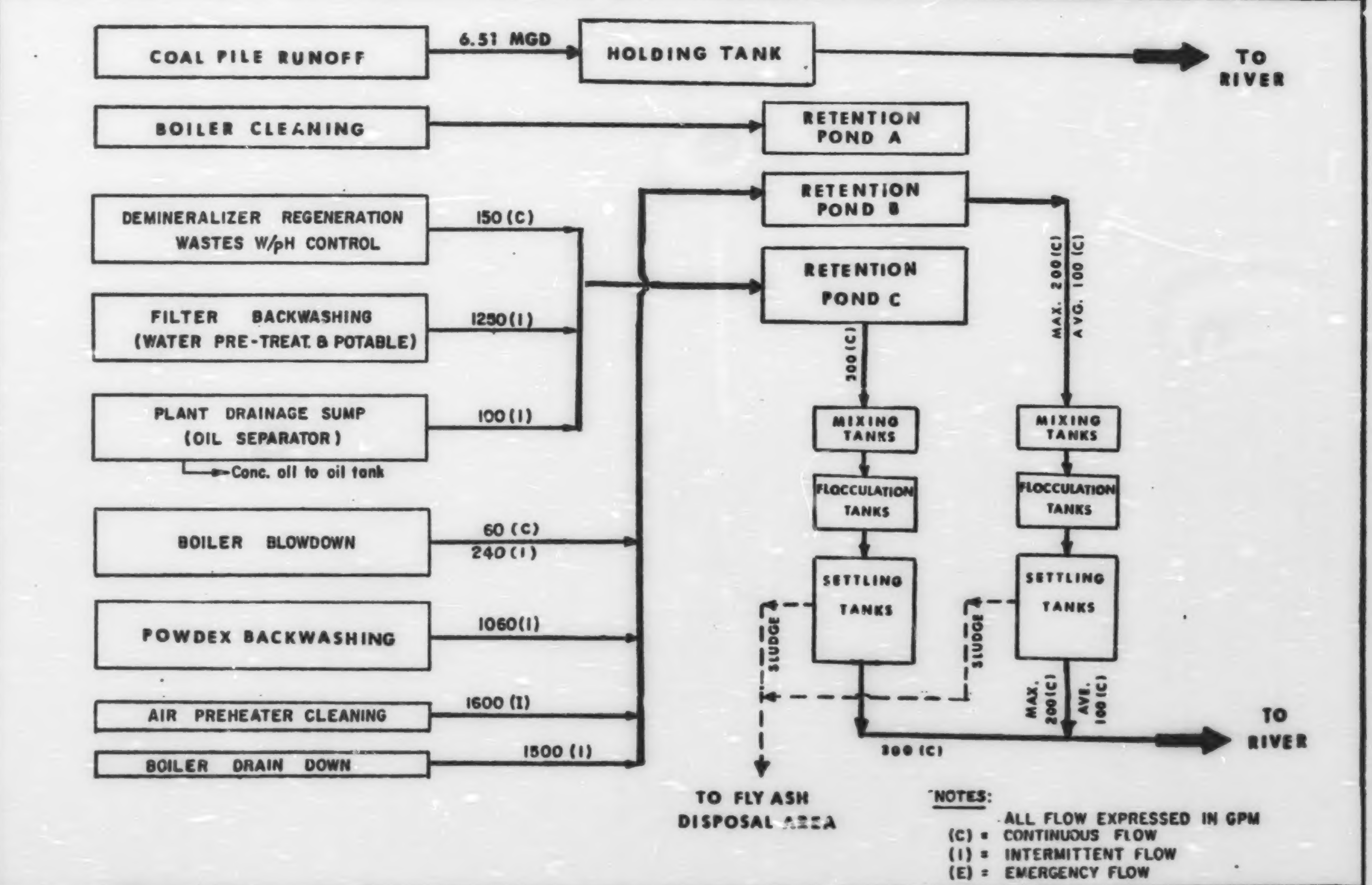
Pond C will be sized at 50,000 gallons for equalizing the filter backwash flow. The pond will discharge a continuous flow of 300 gpm to the downstream physical treatment process.

a. Demineralizer Regenerant Wastes Neutralization

Demineralizer regenerant wastes and acid wastewater from the acid drainage sump will be conveyed to a neutralization basin (approximately 180,000 gallons) for neutralization and flow equalization. Subsequently, the self-neutralized wastewater will be discharged at a controlled rate of 150 gpm and pH adjusted within the range of 6.5 - 9.0 prior to flowing to Retention Pond C for treatment as described in "d" below.

b. Treatment of Oily Wastes - Floor Drainage

All plant areas that have the potential for producing oil spills will be equipped with drains to collect all liquid wastes. These streams will be piped to an oil-water separator system for treatment.


COAL PILE RUNOFF
6.51 MGD
HOLDING TANK
TO RIVER
BOILER CLEANING
RETENTION POND A
DEMINERALIZER REGENERATION WASTES W/pH CONTROL
150 (C)
RETENTION POND B
FILTER BACKWASHING (WATER PRE-TREAT. & POTABLE)
1250 (I)
RETENTION POND C
PLANT DRAINAGE SUMP (OIL SEPARATOR)
100 (I)
Conc. oil to oil tank
MAX. 200 (C)
AVG. 100 (C)
300 (C)
MIXING TANKS
FLOCCULATION TANKS
SETTLING TANKS
MIXING TANKS
FLOCCULATION TANKS
SETTLING TANKS
BOILER BLOWDOWN
60 (C)
240 (I)
POWDEX BACKWASHING
1060 (I)
SLUDGE
SLUDGE
AIR PREHEATER CLEANING
1600 (I)
MAX. 200 (C)
AVE. 100 (C)
BOILER DRAIN DOWN
1500 (I)
300 (C)
TO RIVER
TO FLY ASH DISPOSAL AREA

NOTES:

ALL FLOW EXPRESSED IN GPM
(C) = CONTINUOUS FLOW
(I) = INTERMITTENT FLOW
(E) = EMERGENCY FLOW

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IOWA PUBLIC SERVICE COMPANY – NEAL UNIT 4

PROPOSED CHEMICAL WASTES COLLECTION AND TREATMENT SYSTEM

DATE:

SCALE:

EXHIBIT

II-B-8

Wastewater Source	Flow Rate (gpm)	Assumed Duration (hr/operation)	Total Wastewater Volume	Recommended Basis for Treatment Process Design Capacity (gpm)
Pond B:				
Boiler blowdown	60	Continuous	86,400 gpd	60
Boiler blowdown	240	1.0	14,400 gpd	10
Powdex backwashing	1,060	0.5	31,800 gallons	15
Air preheater cleaning	1,600	2.0	192,000 gallons	100
Boiler draindown	1,500	3.0	270,000 gallons	100
Pond C:				
Demineralizer regenerant wastes	150	Continuous	216,000 gpd	150
Plant drainage sump	100	20	120,000 gpd	100
Filter backwashing	1,250	0.3 (Twice per day)	45,000 gpd	50

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

UNIT 4 WASTEWATER FLOWS

DATE:

SCALE:

TABLE
II-B-8

The oil-water separator system will have a capacity of 100 gpm and will consist of two stages. The first stage will remove free oil and suspended solids by gravity separation, and will prevent the second stage from being overloaded with high free oil concentrations. The second stage will employ coalescence to break emulsions.

The emulsions can be of two types, mechanical and chemical. Mechanical emulsions result from physical agitation. For example the use of centrifugal pumps will produce mechanical emulsions. Chemical emulsions result from the addition of surfactants which form stable emulsions. Chemical emulsions cannot normally be broken by physical means. When chemical emulsions are present, pretreatment will be required to destabilize the emulsion. The addition of alum, with or without pH adjustment, is commonly used to break chemical emulsions. Once the emulsion is broken, physical methods are again used to separate the oil.

c. Treatment of Metal Cleaning Wastewater

Physicochemical treatment will be provided to treat Neal Unit 4 wastewaters expected to contain relatively high concentrations of iron and/or copper. As indicated in Exhibit II-B-8, Pond B discharge will be directed to a mixing tank where pH will be adjusted and polymer added to enhance precipitation of metal ions. Mixing tank effluent will flow to a flocculation tank for development of adequate flocs, and then discharged to a settling tank. Sludge will be disposed of at the fly ash disposal area.

The pH of the chemically treated effluent will be adjusted if necessary to meet pH limitations (6.5 to 9.0) before being discharged to the Missouri River.

d. Treatment of Non-Metal Contaminated Wastes

Retention Pond C effluent will require only physical treatment to satisfy effluent limitations as determined on a net discharge basis. The flow will be controlled at an average rate of 300 gpm and directed to a mixing tank for pH adjustment and polymer addition as required. The wastewater will then flow to two settling tanks for suspended solids removal. The provision of two settling tanks will allow periodic maintenance of a settling tank without affecting treatment of these flows. The settling tank effluent will satisfy applicable requirements and will be discharged to the river.

e. Treatment of Sanitary Wastewater

Sanitary wastewater treatment will be accomplished with a Smith and Loveless "Oxigest" treatment plant. The system will be operated in an extended aeration activated sludge mode and will be designed to treat a daily BOD loading of 20 pounds and have a hydraulic capacity of 10,000 gpd. A removable stainless steel screening basket will be provided to remove unusually large solids from the raw wastewater entering the plant. The aeration chamber will provide approximately a 24-hour detention time at design flows.

The aeration system will consist of two blowers with a design capacity of 46 cubic feet per minute (cfm) at 3.5 psig. At a flow of 100,000 gpd, the clarifier will provide a minimum overflow rate of 263 gpd/sq ft. The effluent will be discharged into a leaching field and will not exceed 25 mg/l BOD5 and 25 mg/l suspended solids.

Excess sludge will be periodically removed from the system and disposed of at a local treatment facility.

f. Treatment of Coal Pile Runoff

To treat coal pile runoff a holding pond will be provided with sufficient storage capacity to retain the entire 6.51 mgd resulting from a 10 year 24 hour rainfall event. The pond also will provide sufficient detention time to produce an effluent with a total suspended solids concentration of less than 50 mg/l.

10. Solid Waste Disposal Area

The solid waste disposal area will consist of approximately 114 acres of land and will provide storage for sludge and ash generated by Neal Unit 4. Ash will be mixed with water (approximately 15 percent by weight) during transport by truck to minimize fugitive dust emissions during unloading. Operational procedure will include alternating layers of waste material with layers of soil to provide the potential for reclamation of this area at some future date. Provisions will be made at the solid waste disposal area via water truck to maintain fugitive dust emissions at a minimum level.

11. Transmission Facilities

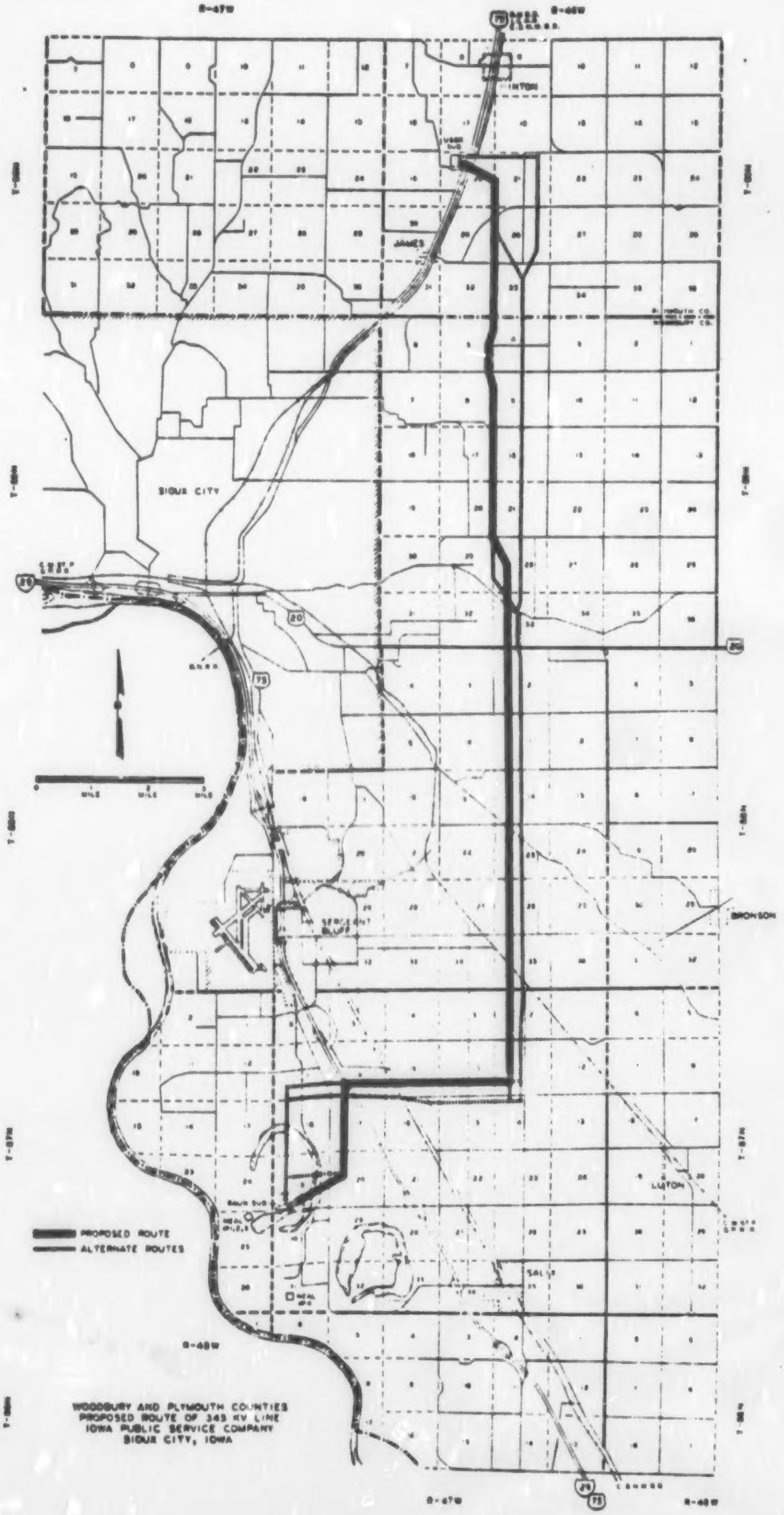
The additional transmission facilities that will be required for Neal Unit 4 will consist of a 345 kV line, 1.82 miles in length, connecting the Raun Substation to the proposed Neal 4 Substation. Right-of-way for this line segment will be predominantly across land owned by Iowa Public Service Company. The remaining portions will be located either on the Woodbury County road right-of-way or on rights-of-way secured by voluntary easement from industrial customers located along the route. No special maintenance requirements of these rights-of-way are expected since all properties traversed by the line are either under cultivation or will be mowed by either the county or private property owner. This route was selected from among several alternate routes and was authorized in all details by action of the Iowa Commerce Commission Decision and Order dated September 25, 1975, under Docket No. E-17776.

A 345 kV line approximately 23.3 miles in length is planned to connect Raun Substation and the U.S. Bureau of Reclamation, Sioux City substation located near Hinton, Iowa. The line will be supported by steel pole H-frame structures averaging 105 feet in height. No special maintenance requirements of the right-of-way are anticipated because of the agricultural nature of the land. The route is depicted on Exhibit II-B-9. Acquisition of right-of-way will be conducted under the rules of the Iowa Commerce Commission.

Route selection for transmission facilities was determined on the basis of aerial photographic interpretation, land use considerations, distance between terminals and consultation with the Iowa Commerce Commission. The environmental criteria and guidelines to be followed for the transmission facilities will consider those set forth by the U.S. Department of Interior and Agriculture and will be in conformance with the rules of the Iowa Commerce Commission.

12. Permits

Table II-B-9 presents a listing of permits, certifications and approvals required from various governmental regulatory agencies in connection with the construction and operation of Neal Unit 4.


R-47W
R-46W
HINTON
JAMES
PLYMOUTH CO.
WOODBURY CO.
SIOUX CITY
BRONSON
LUTON
SALIX
NEAL SUB
NEAL #1,2,3
NEAL #4
0 1 MILE 2 MILE 3 MILE
PROPOSED ROUTE
ALTERNATE ROUTES
R-46W
WOODBURY AND PLYMOUTH COUNTIES
PROPOSED ROUTE OF 345 KV LINE
IOWA PUBLIC SERVICE COMPANY
SIOUX CITY, IOWA
R-47W
R-46W

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

TRANSMISSION ROUTES

DATE:

EXHIBIT

II-B-9

AGENCY	PERMIT	FILED	APPROVED
Federal Aviation Administration	Stack Construction Approval #75-CE-579-OE	11-12-75	1-19-76
Iowa Natural Resources Council	Boiler Bldg. Construction Approval #75-CE-579-OE	11-12-75	12-30-75
Woodbury County Planning & Zoning	Certificate of Zoning Compliance	8- 6-75	3- 1-76
	#ZA 404 Building Permit	8- 6-75	3- 1-76
Corps of Engineers	Construction on Rivers (Sect 10) (Includes Sect 404 Permit)	10- 6-75	
Iowa Conservation Commission	Construction of Intake & Discharge Structures	7-22-76	8-13-76
Environmental Protection Agency	Determination under Sect 316 (a) and (b)	5-31-74	
	NPDES (National Pollution Discharge Elimination System	5-74	
	Non Significant Deterioration Declaration - Sect 306		5-26-76
Iowa Dept of Environmental Quality	Sanitary Disposal System Construction	7-30-75	
	Sanitary Disposal System Operation	7-30-75	
	Temporary Permit to Discharge Water	8-23-74	9-10-74
	Waste Water Disposal System Construction	3-30-76	
	Waste Water Disposal System Operation	8-23-74	

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IOWA PUBLIC SERVICE CO. - NEAL UNIT 4

PERMITS REQUIRED

DATE:

TABLE
II-B-9

AGENCY	PERMIT	FILED	APPROVED
Iowa Dept of Environmental Quality	Waste Water Disposal System Certification Sect 401		
	Air Pollution Control Equipment Construction-Precipitator	1-26-76	4-15-76
	Air Pollution Control Equipment Construction-Coal Handling		
United States Geological Survey	Mining Permit Reclamation Permit		
Wyoming Department of Environmental Quality	Land Permit, Water Permit Air Permit		
Sweetwater and Carbon Counties Planning and Zoning Department	Building Permits		

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IOWA PUBLIC SERVICE CO - NEAL UNIT 4

PERMITS REQUIRED

DATE: SCALE:

TABLE II-B-9 (Cont'd)

III - ENVIRONMENTAL SETTING WITHOUT THE PROJECT

A. GEOLOGY

The site for Neal Unit 4 is located within the Middle Western Upland Plain physiographic sub-unit. Most of the region is covered by varying thicknesses of Pleistocene to recent sediment consisting of glacial tills, loess, glacial outwash and river deposits. Bedrock in the region is generally flat lying or slightly dipping south and east.

1. Geomorphology

The landforms, soils and surficial geology of the proposed site itself, are expressions of the dynamics of the Missouri River. Physiographically the site is located on the broad, nearly flat alluvial plain of the river. This plain was formed as the meandering river shifted its course between the loess capped bluffs (over 3 miles to the southwest and over 5 miles to the Northeast) over a period of geologic time. Evidence of this shifting can be seen in the oxbow lakes of the area, such as Browns Lake and meander scars visible in the aerial photos of the flood plain.

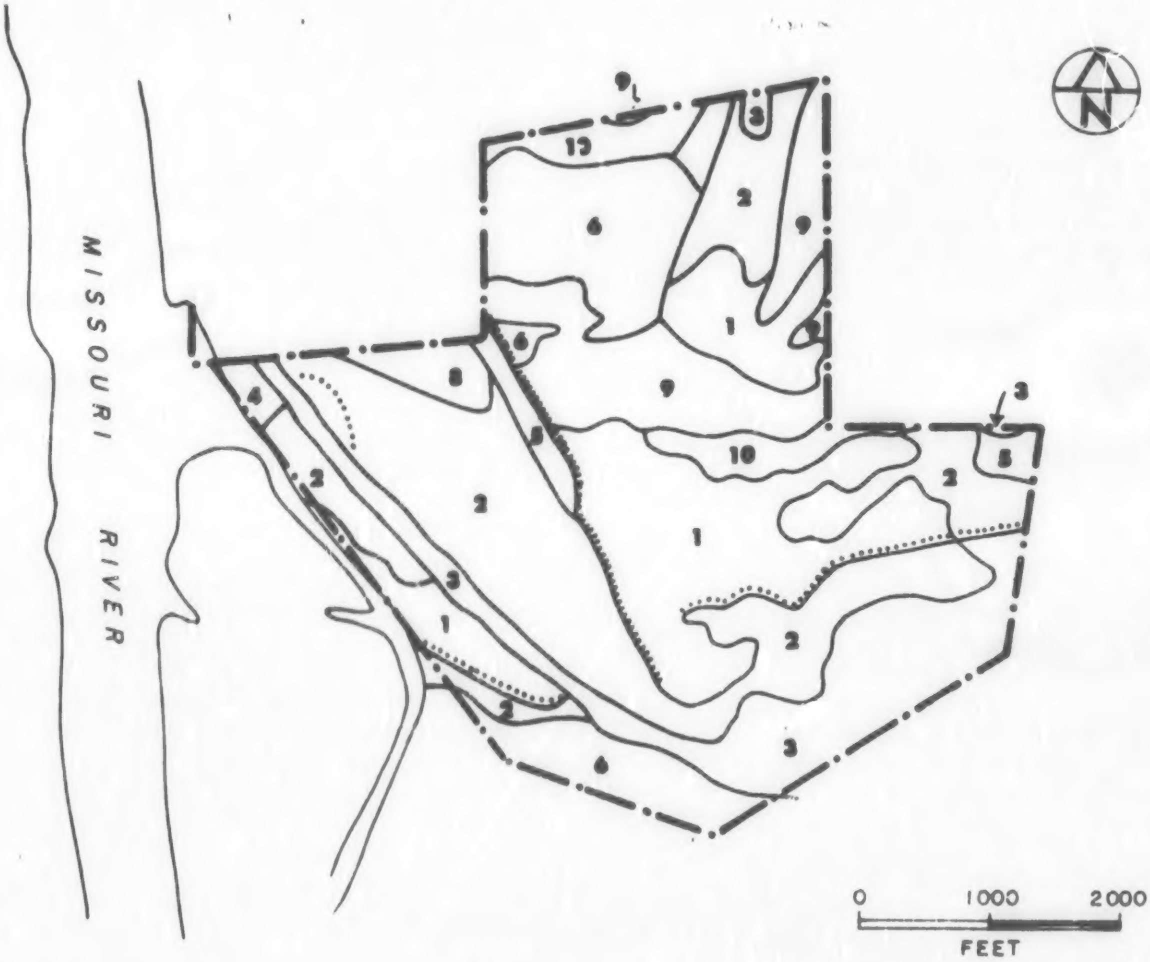
The channel in the vicinity of the proposed site has adjusted radically over the past two hundred years both naturally and through man's intervention. Schumm[1] recounts how the river between Sioux City and Platteville has been reduced in length from about 250 miles in 1804 to approximately 135 miles in 1960. The alluvial land to the south of the proposed site represents an abandoned reach of channel.

The plant site is located on the outside of a meander bend. Typically, this is an area of bank instability and unless protected, erosion can be expected to occur. Conversely, it is an optimum point for water extraction as less silting of intake works would occur at this point of the river bank.

As the river has shifted laterally the different materials deposited have corresponded to the energy of that part of the fluvial system. This alluvial material varies from fine silts and clays deposited in low energy situations, such as in oxbow lakes to coarse gravels and sands deposited in high energy environments such as bars.

2. Bedrock

The lateral variability can be seen in the soil types which form on the different materials. Exhibit III-A-1 is a map of the soil series in the vicinity of the proposed site. These series are identified and their properties are described in Table III-A-1. They are representative of the Albaton-Haynie-Onawa Association of alluvial soils.


MISSOURI RIVER
1
2
3
4
5
6
8
9
10
13
N
0
1000
2000
FEET

1 - Haynie Silt Loam

2 - Blake Silty Clay Loam

3 - Onawa Silty Clay

4 - Mondale Silt Loam

5 - Albaton Clay

6 - Sarpy Loamy Fine Sand

7 - Alluvial Land

8 - Grable Silty Clay Loam

9 - Grable Silt Loam

10 - Carr Fine Sandy Loam

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

SOILS INDEX MAP

DATE:
SCALE:

EXHIBIT
III-A-1

Map Symbol	Name	Depth (inches)	Unified Classification	Permeability (in. hr)	Shrink-Swell Potential	Remarks
1	Haynie Silt Loam	0-90	ML or ML-CL	0.63 – 2.0	Low	Erodible; possible dust or blowing soil hazard
2	Blake silty clay loam	0-20 20-60	CL or CH ML-CL or ML or CL	0.2 – 2.0 0.63 – 6.3	Moderate to High Moderate	
3	Onawa silty clay	0-29 29-60	CH CL or ML-CL	0.06 – 0.2 0.63 – 6.3	High Low to Moderate	May be wet and boggy; severe leach field limitations
4	Mondale silt loam	0-10 10-12 21-90	CL; CH or ML-CL ML-CL CH	0.63 – 2.0 0.63 – 2.0 < 0.2	Moderate Moderate High	Severe leach field limitations
5	Albaton clay	0-60	CH	< 0.02	High	May be wet and boggy; severe leach field limitations
6	Sarpy loamy fine sand	0-24 24-60	SM or SP-SM SM or SP-SM	> 20.0 >20.0	Low Low	May be subject to blowing and dust hazard
7	Alluvial land		GC-SP	–	–	Highly variable; severe leach field limitations
8	Grable silty clay loam	0-10 10-20 20-60	CL or ML-CL ML SM	0.63 – 2.0 0.63 – 2.0 6.3 – 20.0	Moderate Moderate Low	May be wet and boggy
9	Grable silt loam	0-20 20-60	ML SM or SP-SM	0.63 – 2.0 6.3 – 20.0	Low to Moderate Moderate	–
10	Carr fine sandy loam	0-33 33-70	SM or SC SM	2.3 – 6.3 2.0 – 6.3	Low Low	Erodible and may be subject to liquefaction

Source Worster, et al 2/

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

SOIL PROPERTIES IN THE AREA OF THE NEAL SITE

DATE:

SCALE:

TABLE III-A-1

While depositing laterally the river has also built up a thick vertical accumulation of material. Preliminary drillings at the site show at least 74 feet of sands and silts near the river bank. Water wells and other borings in the vicinity of the proposed site show that from 110 to 150 feet of alluvium covers the underlying bedrock.

The topmost bedrock units found at depth in the area are the Cretaceous Dakota Group of sandstones and shales. These are relatively flat lying and have an approximate thickness of 3000 feet. The next oldest unit is a 500 foot thickness of Devonian and Upper Ordovician limestone. Lower Ordovician strata are represented by the Decorah-Platteville Formation, the St. Peter sandstone and the Praire-Du Chien dolomite. Depths and thicknesses of the later formations are difficult to estimate for the Sioux City region because of the lack of deep wells.

3. Mineral Resources

Except for sands and gravels found in the alluvium, there are no known mineral resources among the earth materials present. No active mining of the aggregates is done locally.

4. Seismology

The proposed site is located in the relatively inactive Central Stable Platform between the Sioux Uplift and the Forest City Basin. There are no known major active faults in the area; however, it is in a Zone I seismic risk area implying minor seismic accelerations may be expected and designed for. The closest earthquake to the site occurred near Sioux City, about 10 miles to the north, in 1872. This quake had an intensity of V (Modified Mercali 1931) indicating only slight damage such as cracked plaster in some buildings. Table III-A-2 includes the other earthquakes which have been felt in the vicinity of the proposed site in recent history. All of these may be considered intermediate to minor in intensity. The strongest, with an Intensity of VII, caused little damage to properly designed and constructed buildings. No surface disturbance or fissuring has been noted for any of these quakes.

Year	Location	Intensity*	Approximate Distance From Site (Miles)
1872	Sioux City, Iowa	V	10
1879	South Dakota	V	70
1902	Eastern Nebraska	V	70
1910	Columbus, Nebraska	V	80
1938	Sioux Falls, Nebraska	V	90
1877	Eastern Nebraska	VII	110
1911	South Dakota	V	170
1967	South Dakota	V	170
1927	White Cloud, Mo.	V	190
1946	Wessington, S.D.	VI	190
1906	Manhattan, Kansas	VII	230
1867	Lawrence, Kansas	VII	250

Source: NOAA [3/].

*Modified Mercali, 1931

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

SEISMOLOGY IN THE AREA OF THE NEAL SITE

DATE: SCALE:

TABLE III-A-2

B. HYDROLOGY

1. Surface Water

The Missouri River is the primary source of surface water for the George Neal Steam Electric Station.

Descriptions of this River have appeared numerous times in the literature [1,2,3] but will be reviewed briefly here to provide a scenario for detailed ecological data to follow (Section III-C).

The Missouri River originates in southern Montana, and flows for about 1833 miles before reaching the proposed Neal Unit 4 site. It is the longest river in North America, traversing over 2464 miles and seven states before joining the Mississippi River above St. Louis, Missouri. It drains approximately one-sixth of the continental United States and a small part of Canada[1] and over its course declines from an elevation of about 1860 feet mean sea level (MSL) to about 1070 feet MSL. Records of stream flow maintained by the U.S. Geological Survey at the Sioux City gage station, 16 miles above the Neal site, show an average discharge of 31,860 cubic feet per second (cfs) when computed over a 77-year period. However, these averages are higher than present mean discharge rates due to the inclusion of many years of preimpoundment data in the calculations.

While extreme flows of 2500 to 441,000 cfs have been noted at Sioux City, Iowa in the past, the river is now regulated as a result of Congressional legislation (Flood Control Act of 1944) which authorized the construction of impoundments on the upper Missouri River and its tributaries.

The river flow in the Missouri River main stem is controlled by a series of six storage reservoirs located above Sioux City and operated by the Reservoir Control Center, Missouri River Division of the U.S. Army Corps of Engineers (Corps of Engineers) located in Omaha, Nebraska. These reservoirs are Fort Peck (mile 1775), Fort Randall (mile 880), Garrison (mile 1390), Oahe (mile 1072), Big Bend (mile 987), and Gavins Point (mile 811). They were completed in 1943, 1956, 1960, 1963, 1964 and 1964 respectively. The normal operation of the Missouri River main stem reservoir system did not commence until 1967. In 1964 construction was completed on the Big Bend dam, the last of the main stem dams, located south of Pierre, South Dakota; however, due to the meteorological conditions which persisted in the entire main stem reservoir drainage area during the period from 1964 through 1967, the initial fill of the overall system was not accomplished until 1967. At full capacity, these reservoirs impound water in over one-half of the upper 1500 miles of river[2]. Gavins Point Dam is used by the Corps of Engineers to regulate downstream flows in the Missouri River and acts as a control for the section of the Missouri in the vicinity of the Neal site.

Releases of water from Gavins Point Dam during the navigation season, from about April 1 to December 1, are dictated by navigation needs to provide a 9-foot navigation channel extending from Sioux City to the mouth of the Missouri River. The channel has more or less been stabilized with pile or stone fill dikes and revetments to maintain an average river width of 800 feet and a navigation channel width of 300 feet. Under normal flow conditions, the velocity of the streamflow in the vicinity of the Neal site varies between 3 and 5 feet per second (fps).

Releases of water from Gavins Point Dam during the non-navigation season, from about December 1 to April 1, are scheduled to meet the interim flow requirements for stream sanitation and supplemental power generation. At present, the minimum flow release anticipated by the Corps of Engineers during the non-navigation season is about 6000 cfs.[5] Local flooding caused by river ice jams are experienced during the winter season. The length of the Missouri River navigation season is determined by the initial freeze and breakup dates of the ice flows in the river. According to a recent report by the Corps of Engineers,[6] the months exhibiting the highest potential for river icing are December through March.

a. Monthly River Flows

Appendix Exhibits A-III-B-1 through A-III-B-12 present a statistical analysis of Missouri River flows in the vicinity of the Neal site based on United States Geological Survey (USGS) daily average historical records[7] obtained at the Sioux City gage station for the eight-year period from 1967 through 1974. The results pertaining to maximum, average and minimum daily average flows are given in Table III-B-1. In addition, the predicted average monthly Missouri River flows at Sioux City, Iowa based on the Corps of Engineers' study[4] for the current (1970) level of basin water resource development followed by a recurrence of the hydrologic period 1898-1972 are presented in Table III-B-2 along with the USGS recorded river flows for the period 1967-1974.

b. Low Flow Conditions

In order to determine the appropriate low flow for the river in the vicinity of the Neal Station, the flows during the eight year period 1967-1974 (this period represents normal system operation) were analyzed statistically for the one in ten year minimum average seven consecutive day low flow (MA7CDLF), and then adjusted (by several methods) to correct for the above average runoff during this period.

The procedure utilizing the Gumbel distribution[8] is to take the MA7CDLF for each of the eight years of record, and plot these low flows on Gumbel paper using the Weibull[9] plotting position for the observed flows. The MA7CDLF for each of the eight years is as follows:

Month	Maximum Flow (cfs)	Mean Flow (cfs)	Minimum Flow (cfs)
* January	28,400	16,750	5,000
* February	60,000	18,950	6,270
* March	41,800	26,340	7,400
April	76,400	35,910	24,200
May	51,200	36,530	24,600
June	69,800	38,010	21,100
July	54,100	38,900	29,400
August	58,500	41,670	31,000
September	56,500	40,850	27,800
October	53,100	39,620	24,400
*November	55,700	38,500	13,700
*December	48,200	20,290	6,240

* Months exhibiting the highest potential for river icing.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

MISSOURI RIVER FLOW RATES AT
SIOUX CITY, IOWA
1967-1974

DATE: SCALE:

TABLE III-B-1

AVERAGE MONTHLY MISSOURI RIVER FLOWS AT SIOUX CITY, IOWA FOR THE PERIODS 1898-1972 and 1967-1974

Month	Average Flow (cfs) for the Period 1898-1972 Based on the Current Basin Development (a)	Average Flow (cfs) for the Period 1967-1974 (b)
January	15400	16750
February	17000	18950
March	26200	26340
April	32700	35910
May	32800	36530
June	33200	38010
July	35000	38900
August	36800	41670
September	36400	40850
October	34900	39620
November	35100	38500
December	17700	20290
Annual	29400	32690

(a) Based on Corps predictions.

(b) Based on USGS flow records.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

COMPARISON OF PREDICTED AND MEASURED AVERAGE MONTHLY RIVER FLOWS

DATE:

SCALE:

TABLE III-B-2

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Year	MA7CDLF (cfs)
1967	7,410
1968	10,966
1969	10,231
1970	12,157
1971	12,857
1972	17,143
1973	20,271
1974	13,929

The above data were plotted as a frequency distribution on Gumbel paper and the 1 in 10 year MA7CDLF was extrapolated. For the years 1967-1974, the 1 in 10 year MA7CDLF is about 7200 cfs as shown on Exhibit III-B-1.

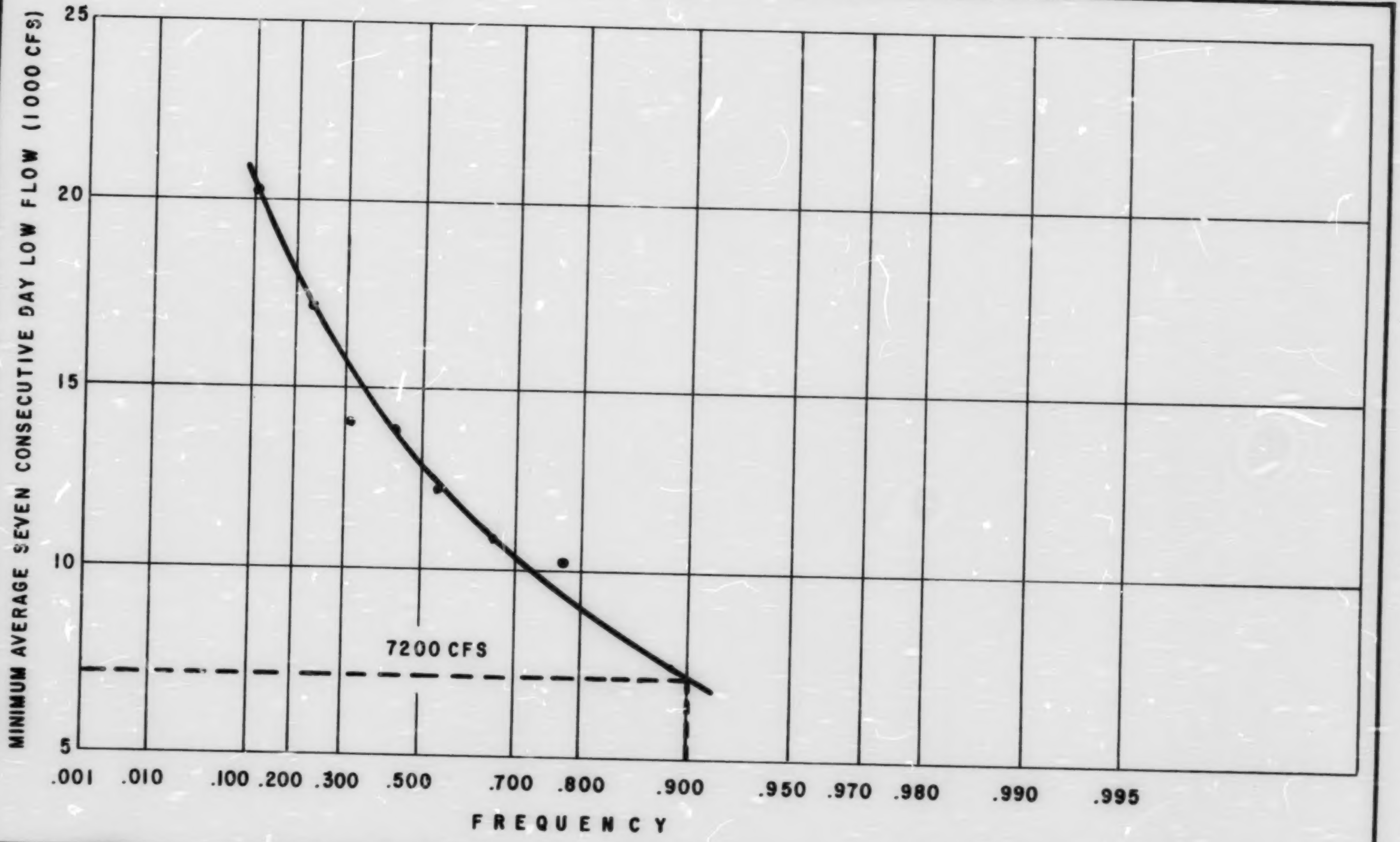
Having obtained the 1 in 10 year MA7CDLF for the 1967-1974 period, the low flow was adjusted by three methods to correct for the above average runoff during this period. The first method was to compare the average runoff from the Missouri River Drainage Basin above Sioux City for the period from 1898 to 1974, with the above average runoff over the same basin for the period from 1967 to 1974. The average runoff for the former period was 24,600,000 acre-feet, and 28,030,000 acre-feet for the latter period*. The resulting correction factor is 0.88. Applying this factor to the 1967-1974 1 in 10 year MA7CDLF, the adjusted flow becomes 6336 cfs.

The second method was to compare the Missouri River flow in the vicinity of Sioux City, Iowa for the period 1898 to 1966, with the period 1967 to 1974. The average flow for the former period was 31,680 cfs, and for the latter period, it was 32,730 cfs. The resulting correction factor is 0.97. Applying this factor, the adjusted 1 in 10 year MA7CDLF is 6984 cfs.

The third method was to compare the Corps predicted Missouri River flows for the current (1970) level of basin water resource development followed by a recurrence of the hydrologic period from 1898 to 1972, with the measured flows at Sioux City for the 1967 to 1974 period. Table III-B-2 shows these average flows. The average annual flow for the former period was 29,400 cfs, and 32,690 cfs, for the latter period. The resulting correction factor is 0.90, and the adjusted 1 in 10 year MA7CDLF becomes 6480 cfs.

The correction factors and adjusted low flows determined by these three methods are tabulated below:

Method	Correction Factor	Adjusted 1 in 10 year MA7CDLF
1	0.88	6336 cfs
2	0.97	6984 cfs
3	0.90	6480 cfs



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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

DISTRIBUTION OF MA7CDLF FOR THE
MISSOURI RIVER AT SIOUX CITY, IOWA, 1967-1974

DATE:

SCALE:

EXHIBIT
III-B-1

On the basis of this analysis, it is concluded that a representative 1 in 10 year MA7CDLF for the current method of river operation would be about 6500 cfs.

The Iowa Department of Environmental Quality has based its analysis of low flow on the period of record, 1954-1972. Their analysis for this 19 year period yields a 1 in 10 year MA7CDLF of 6000 cfs[4].

c. Monthly River Temperatures

Based on maximum daily water temperature measurements as recorded during the 11 year period, 1955-1965, at the Omaha Metropolitan Utilities District (MUD) Florence Water Treatment Plant (located 85 miles south of the Neal Station) and reported by Ebasco[10] the estimated frequencies that given temperatures are equaled or exceeded are as follows:

Temperature (°F)	Frequency Equaled or Exceeded (percent)
84	0.32
83	0.91
82	1.98
81	3.75

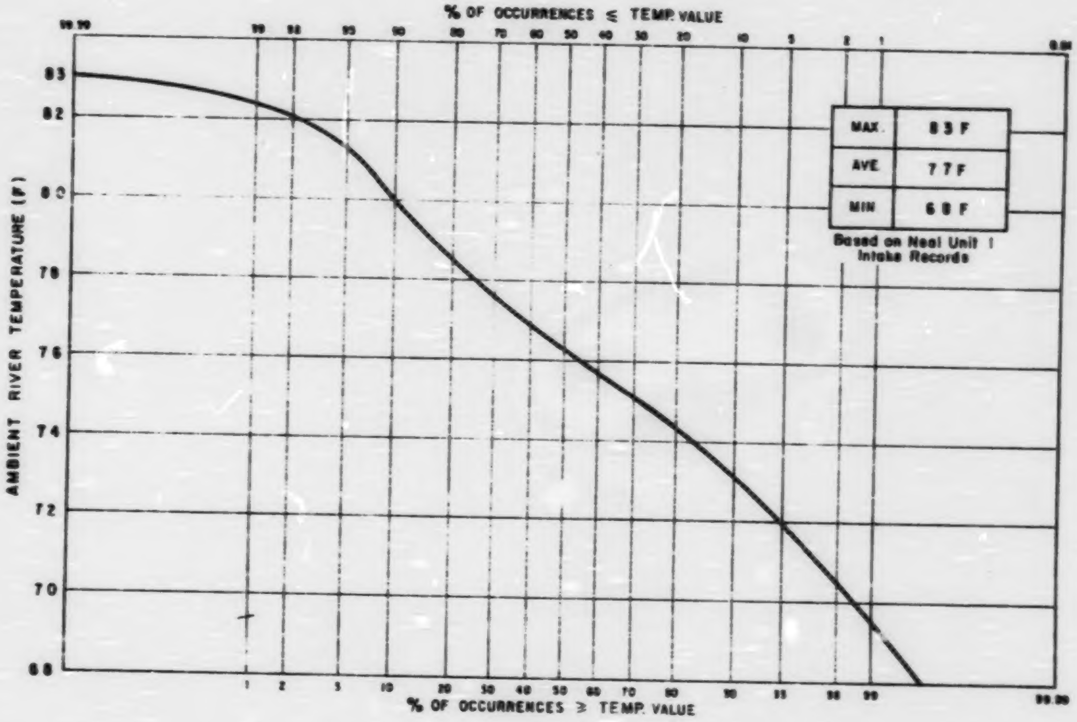
Based on the analysis of daily temperature data recorded at the Neal Station Unit 1 intake during the nine year period 1964-1972[11], the monthly average temperature ranges from 36°F in January to 77°F in July. The minimum daily temperature ranges from 33°F during the months of December through March to 68°F in July. Maximum daily temperatures range from 47°F in January to 83F in July.

Exhibit III-B-2 presents the statistical analysis for July which represents a typical summer month. Analysis of winter water temperatures yields values slightly higher than the actual ambient river temperature due to interference from the recirculation of a small volume of discharge water in front of the Unit 1 trashracks to prevent icing. It is estimated that this deicing recirculation may raise the water temperature entering the plant by about 1 degree Fahrenheit (F).

Table III-B-3 presents the monthly average, minimum and maximum ambient river temperatures based on the statistical analysis of data measured daily at the Unit 1 intake.

2. Groundwater

The Missouri River Valley in the vicinity of the Neal site has two major aquifers, the Dakota sandstone and the alluvial fill of the valley. The Dakota sandstone is a high yielding artesian aquifer which is used extensively for community and commerical supplies to the north and east of the site. Sioux



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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

MISSOURI RIVER AMBIENT TEMPERATURE
JULY

DATE:

SCALE:

EXHIBIT
III-B-2

2

Month	Max Temp (F)	Mean Temp (F)	Min Temp (F)
January	47	36	33
February	48	36	33
March	59	40	33
April	66	51	36
May	84	60	43
June	89	71	57
July	83	77	68
August	81	75	66
September	78	67	52
October	67	56	45
November	54	43	35
December	50	37	33

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

MISSOURI RIVER AMBIENT WATER TEMPERATURES

DATE: **SCALE:**

TABLE III-B-3

City obtains its water supply, approximately 28 million gallons per day (mgd), from 16 wells in the Dakota sandstone. These wells yield up to 1400 gallons per minute (gpm)[12].

Wells utilizing the Dakota aquifer are not found in the immediate vicinity of the site. The closest are those in the Sergeant Bluff area, about 6 miles to the north. These wells yield between 20 and 600 gpm from the Dakota layer which is about 340 feet thick. The sandstone aquifer is generally topped by 15 to 90 feet of shale. Wells drilled to the Dakota Group near the existing Neal units indicate the existence of a least five feet of shale and up to 140 feet of alluvial fill.

The sands and gravels deposited in the Missouri River Valley constitute another major aquifer. In the immediate vicinity of the site the alluvium is tapped primarily for domestic and industrial water supplies.

A sample of wells within two miles of the site shows that a number of residences obtained water supplies from well points in the alluvium. These are generally bacteriologically safe but may have problems with high iron or hydrogen sulfide content[13]. More than 15 miles to the southeast, the towns of Onawa, which has wells yielding 2.2 mgd, and Whiting, with wells yielding 0.4 mgd, use the alluvium as a source of their community supplies.

The depth of groundwater varies from near surface adjacent to the river, to about 18 feet in some parts of the site. The water table appears to slope generally downstream and toward the river. As the river and aquifer appear to be hydraulically connected, fluctuations in the river level will cause fluctuation in the groundwater level.

Yields from the alluvial aquifer may be quite high because of the permeable nature of the sands and gravels. Five 12-inch wells were drilled in 1965 for the Terra Chemical Company which is located adjacent to the existing units. The wells were 110 feet deep and produced 650 gpm with only 2 to 6 feet of drawdown with a specific yield of 200 to 300 gpm per foot of drawdown.

3. Water Usage

The major users of water in the vicinity of the proposed site are industries and the George Neal Steam Electric Station. The municipalities of Sioux City, Iowa and Dakota City, Nebraska are the major municipal users.

The industrial facilities include livestock and meat processing, food processing and fertilizer manufacturing and together with the municipalities utilize groundwater for their needs. The Neal Station uses Missouri River water for the major part of its water requirements.

The list of major water users in the area surrounding the proposed site is given in Table III-B-4. This table also gives the source and quantities for each user and the treatment provided before disposal.

INDUSTRIAL	PROCESS		WATER						
NAME PRODUCT. PROCESS OR SERVICE	WET	DRY	SOURCE	AMOUNT GPM	TREATED	DISPOSAL UNTREATED	RECEIVING	PRODUCT	SEASONAL OPERATIONS
The Beerman Brothers. Sergeant Bluff. Iowa Alfalfa Dehydration		X	No Process Water		No Process Wastewater			Livestock Feed	Yes
Flavor Land Industries. Sioux City. Iowa (Formerly Needham Packing) Cattle Processing	X		3 Wells	695	Screening. City Stp		Missouri	Beef for Consumer Mkt	No
Flavor Land Industries. Sioux City. Iowa (Formerly Needham By Products) Rendering Plant. Meat & Hide By Products	X		2 Wells	2.146	Primary before City Stp		Missouri	Meat and Hide By-Product	No
Iowa Beef Packers. S Sioux City. Nebraska Cattle Processing	X		3 Wells	2.100	Iron Removal Pressure Sand Filters. Aeration		Missouri	Beef for Processors and Market	No
Iowa Public Service Co . Port Neal. Iowa Units 1. 2 & 3 Coal-Fired SES	X		Missouri River and Wells	490.000	Sanitary Septic Tank	Cooling Water Untreated	Missouri	Electric Power	No
Kay Dee Feed Co . Sioux City. Iowa Agricultural Fertilizer		X	Well and City Water	90	No Process Wastewater Cooling Only			Agricultural Fertilizer	Yes
Kind and Knox Gelatin Inc . Sergeant Bluff. Iowa – Gelatin Manufacture	X		Well	695	Plant Flotation		105 Acre Lagoon Evaporation	Gelatin for Food. Pharmaceutical and Photography	No
Nutra Flow. Sioux City. Iowa Manufacturers of Liquid Fertilizer	X		City Water System	1.000	City Stp Daily Sampling Water Quality and Temperature		Missouri & Floyd	Agricultural Fertilizer	Yes
Raskin Packing Co . Sioux City. Iowa Cattle Processing	X		3 Wells	35	City Stp		Missouri	Beef Carcass	No
Sioux City Cold Storage. Sioux City. Iowa Frozen Food Products	X		Well plus City Water	430	No Process Wastewater Heat Exchanger Cooling		Floyd	Frozen Meat & Food Products	No
Sioux City Dressed Beef See Flavor Land Industries									
Sioux City Stock Yards. Sioux City. Iowa Livestock Sales Holding Pens	X	Animal Intake and Flushing	4 Wells	5.530	Crude Screening City Stp		Missouri	Livestock Sales	No
Swift & Co . Sioux City. Iowa Hog Processing	X		Wells	165	Vibrating Screen City Stp		Missouri	Pork Meat Products	No

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

WATER USE AND WASTEWATER TREATMENT AND DISPOSAL IN THE NEAL UNIT 4 AREA
(SHEET 1 OF 2)

DATE:

SCALE:

TABLE
III-B-4

INDUSTRIAL NAME PRODUCT, PROCESS OR SERVICE	PROCESS		WATER					FINAL PRODUCT	SEASONAL OPERATIONS
	WET	DRY	SOURCE	AMOUNT GPM	TREATED	DISPOSAL UNTREATED	RECEIVING		
The Terra Chemical Co., Port Neal, Iowa Ammonia & Nitric Acid Manufacture	X		Wells	660	Stabilization Ponds		Missouri	Fertilizer and Feed	No
United Packing of Iowa, Sioux City, Iowa Slaughter and Process Hogs	X		2 Wells	435	City Ssp		Missouri	Pork Meat Products	No
Wilson Trailer, Sioux City, Iowa Livestock Trailer Cleaning	X		City Water System	36	City Ssp		Missouri	Livestock Trailer Cleaning & Maintenance	No
Farmland Industries, Port Neal, Iowa Soybean Processing		X	Wells	3000	No Process Wastewater Cooling Only		Missouri	Soybean Meal	No

MUNICIPAL	POPULATION	PLANT FLOW - GPM	TREATMENT	RECEIVING
Dakota City Sewage Treatment Plant Dakota City, Nebraska	700	120	Holding Tank – Primary	Missouri
Sioux City Sewage Treatment Plant Sioux City, Iowa	85,000	12,000	Primary Designs and Plans for Secondary Treatment Late '75, Early '76	Missouri

Data Source
Data collected by telephone survey and from the Storet Data Retrieval System of the Optimum Systems Incorporated, 5272 River Road, Bethesda, Maryland, dated August 24, 1973

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

WATER USE AND WASTEWATER TREATMENT AND DISPOSAL IN THE NEAL UNIT 4 AREA
(SHEET 2 OF 2)

DATE:
SCALE:

TABLE
III-3-4

C. WATER QUALITY AND AQUATIC ECOLOGY

1. Overview

The aquatic environment in the region surrounding the proposed Neal Unit 4 is composed of:

- The Missouri River main stem
- Missouri River cutoffs
- Natural Oxbows

Neal Unit 4 will primarily influence the Missouri River main stem. As discussed in detail in Section III-B (hydrology), river flow in the Missouri River main stem is controlled by upstream storage reservoirs operated by the Corps of Engineers. In addition to mandating control of upper Missouri River discharge, Congressional legislation (River and Harbor Act of 1945) also called for channel improvements, or channelization, on the Missouri River and its tributaries.[1],[2] Channelization involves straightening the natural meanders, clearing the banks, and widening and deepening the channel; thus facilitating containment of most floods and, due to a lowered base level, drainage of adjacent flood plains.[3] The Missouri River has been channelized from its mouth just above St. Louis, Missouri, to a point some 52 miles downstream of Gavins Point Dam.[2] Incorporated along its length are various current-directing and/or bank stabilizing structures, including pile dikes, trail dikes, and revetments.[1] Examples of these structures are apparent in Exhibit III-C-1.

Besides the main channel and channel banks, the Missouri River has numerous backwater areas along its course called "cutoffs." Most of these are "open", that is they are diked at their upper ends, and open to the river at their lower ends. Open cutoffs are shallow, horseshoe-shaped waters.[4] Their depths vary markedly in response to river discharge and they provide boat access from the river only at times of maximum discharge. Certain cutoffs have been closed at their lower ends, and fish management programs have been undertaken in them.[4].

In the Sioux City area there are three principal sources of waste discharges into the Missouri River: domestic wastes; industrial wastes associated with food processing (meat packing in particular); and wastes from ammonium nitrate and insecticide manufacturing plants.[5] All wastes discharged to the Sioux City municipal sanitary sewer system had been receiving primary treatment since 1970.[5] There are six major waste water outlets in the Sioux City area[5]. These are associated with:

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

AERIAL VIEW OF THE MISSOURI RIVER
AT PORT NEAL, IOWA

DATE: SCALE:

EXHIBIT
III-C-1

- A packing plant in Dakota City, Nebraska
- The Sioux City municipal waste water treatment plant
- The effluent from chemical plant detention ponds at Port Neal
- Three major stockyards in Sioux City each with a separate discharge.

In addition to point-source discharges, nonpoint sources and land-runoff are also responsible for significant waste input into the Missouri River. Comparison between Environmental Protection Agency (EPA) data from two-day, wet-weather surveys and eight-day, dry-weather surveys, indicate fecal coliform increases of several orders of magnitude during the former period.[5] Such two-to-three day runoff peaks, as indicated on hydrographs for Missouri River tributaries, occur about a dozen times a year on the average.

Basically, organic materials, containing bacteria and viruses are discharged into the Missouri River. Fecal coliform counts are generally in excess of State of Iowa Water Quality Standards of less than 2000 organisms/100 ml (February 12, 1974). In addition, persistence of a fecal sterol, coprostanol, confirmed the presence of relatively fresh animal excreta in the river.[5] Coprostanol is one of the principal sterols in the feces of man and other higher animals - reportedly the only sources of the compound.[6] Salmonella a pathogenic group of bacteria, has been isolated from Missouri River water. Additionally, organic contamination of channel catfish held captive in cages at Sioux City has been indicated by taste panel studies.

The EPA,[5] in summary, stated that the Missouri River represented a potential hazard to anyone using it as a source of drinking water or recreation. It could, however, be restored to a relatively clean river through implementation of existing waste water treatment technology.

Ecologically, the Missouri River provides a variety of habitats. However, the amount of productive habitat has been significantly reduced by channelization over the years. Estimated losses, due to channelization, of Missouri main stem and/or tributary habitat range from 67 percent of the benthic area[2] to 95 percent of the "aquatic habitat".[8] Gould and Schmulbach[7], found almost twice as many fish in the unchannelized portions of the Missouri River as in the channelized portions. Recreational fishing pressure reflects these differences. Green[19], found that the annual fishing pressure on the portion of the Missouri River which includes the Neal 4 site was 901 hr/mile/year. The upstream unchannelized portions of the river received 1,218 hr/mile/year while the Gavin's Point Dam tail waters received 33,886 hr/mile/year. These values can be compared to those reported by Green[19] for other rivers, including the Mississippi (8,811 hr/mile/year) the Des Moines (10,412 hr/mile/year) and the Platte (4,439 hr/mile/year). Still, the

Missouri River below Sioux City supports a characteristic assemblage of fish species, which have been recruited primarily from upstream (unchannelized) areas, wing dike habitats, and cutoffs.

The main channel and channel border of rivers such as the Missouri have fish communities composed of channel and flathead catfish, carp, smallmouth and bigmouth buffalo, carpsuckers, and freshwater drum.[10] These communities differ little from those of large prairie streams, in which, quoting Funk,[10] the "catfish - carp -carpsucker community is prevalent in all but the smallest ... (low-gradient) streams." Other game species in this community include sauger, crappie, bullhead, white bass, northern pike, bluegill, and paddlefish.[4] Carp, drum, goldeye, and channel cat were the fish most frequently taken by sport fisherman[19], and they, as well as flathead catfish, buffalo, and suckers, support a very modest commerial fishery in the Missouri River. Forage species include the gizzard shad, various chubs, shiners, and minnows.

Table III-C-1 presents commercial fishery landings for 1972-1975 from Iowa boundary waters of the Missouri River. Spinner [11] considered the fishery "insignificant", as contrasted to the Mississippi River, and attributed low catches of fish in the Missouri River to stream channelization. As an indication of the magnitude of the fishery, in 1972 there were 400 linear feet of gill net and 11,000 linear feet of trammel net licensed for use in the Missouri River. By contrast, over 250,000 combined linear feet of these gear were licensed for use in Iowa boundary waters of the Mississippi River.[11] Numbers of hoop and slat nets in use on the Missouri and Mississippi Rivers bordering Iowa in 1972 were 94 and 8845, respectively. Missouri River commercial fisheries accounted for an estimated $4,283.88 in 1972, while Mississippi River fisheries were valued at $442,162.56.[11] The total annual recreational value of the fishery from the Gavin's Point Dam to Rulo, Nebraska has been estimated at $619,000.[19]

2. Site Specific Ecological Data

Since July, 1971, Iowa Public Service Company (IPS) has sponsored a detailed pre- and post-operational study of the Missouri River aquatic ecology in the vicinity of Neal Unit 3, located about 1.8 miles up-river from the Neal Unit 4 site. Briefly, the program has involved collecting and analyzing bi-monthly water quality grab samples, and identifying biologic populations and communities along the river. The methodologies employed in the program are summarized in the following paragraphs. A more detailed description of procedures can be found in Appendix A III-C. Water quality analyses were performed according to methods and procedures outlined in Standard Methods for The Examination of Water and Waste Water.[12]

The biotic communities studied included phytoplankton, periphyton, macrophyte, zooplankton, benthic macroinvertetrate,

Species	Harvest* (lbs/Round) 1972	1973	1974	1975	Avg Price/lb ($) 1972	1973	1974	1975	Estimated Value ($) 1972	1973	1974	1975
Carp	17,038	24,510	15,502	17,689	0.05	0.06	0.05	0.05	851.90	1,470.60	775.00	884.45
Buffalo Bigmouth Smallmouth Black	3,693	10,088	6,432	8,742	0.15	0.15	0.16	0.22	553.95	1,513.20	1,029.00	1,923.24
Catfish												
Channel	4,883	6,419	5,186	5,734	0.35	0.46	0.45	0.49	1,709.05	2,952.74	2,333.70	2,809.66
Flathead	1,485	2,688	2,984	2,444	0.35	0.46	0.45	0.49	519.75	1,236.48	1,343.00	1,197.56
Freshwater Drum	916	965	1,248	1,701	0.08	0.10	0.10	0.11	73.28	96.50	124.80	187.11
Sturgeon Sand	147	97	323	734	0.35	0.41	0.35	0.32	51.45	39.77	113.00	234.88
Gar	5	-	-	-	0.04	-	-	-	0.20	-	-	-
Suckers Redhorse Spotted Quillback Carpsucker	7,375	7,946	6,942	3,389	0.05	0.04	0.05	0.05	368.75	317.84	347.00	169.45
Paddle Fish	949	1,230	1,039	1,418	0.15	0.15	0.12	0.15	142.35	184.50	125.00	212.70
Others Mooneye Goldeye Shad	330	412	784	40	0.04	0.02	0.03	0.03	13.20	8.24	24.00	12.00
Bullhead	-	-	68	-	-	-	0.18	-	-	-	12.00	-
TOTAL	36,821	54,355	40,508	41,891	-	-	-	-	4,283.88	7,819.87	6,226.00	7,631.05

*undressed

Source: Spinner 11/

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

COMMERCIAL LANDINGS IN IOWA BOUNDARY WATERS OF THE MISSOURI RIVER (1972-1975)

TABLE
III-C-1

DATE:

SCALE:

and fish. Phytoplankton samples were collected by filtering five gallons of river water through a Wisconsin Net (No. 20,76 u mesh). Zooplankton in the June 1973 - December 1975 sampling period were identified from phytoplankton and drift net studies. However, in the June 1975 - August 1975 study, zooplankton were also collected by towing a metered Wisconsin plankton net so that 150 liters passed through the net. Organisms were identified to lowest possible taxon in replicate samples mounted in a Sedgewick-Rafter cell. A drift net was used to sample invertebrate drift; and a series of artificial substrate baskets was used to collect benthic macroinvertebrates. Quarterly fisheries surveys were conducted using AC electrofishing apparatus, seine nets and gill nets, as conditions allowed. Larval fishes were sampled with Wildco stream drift nets.

From July 1971 through April 1973, water quality and plankton samples were taken along three transects (Exhibit III-C-2):

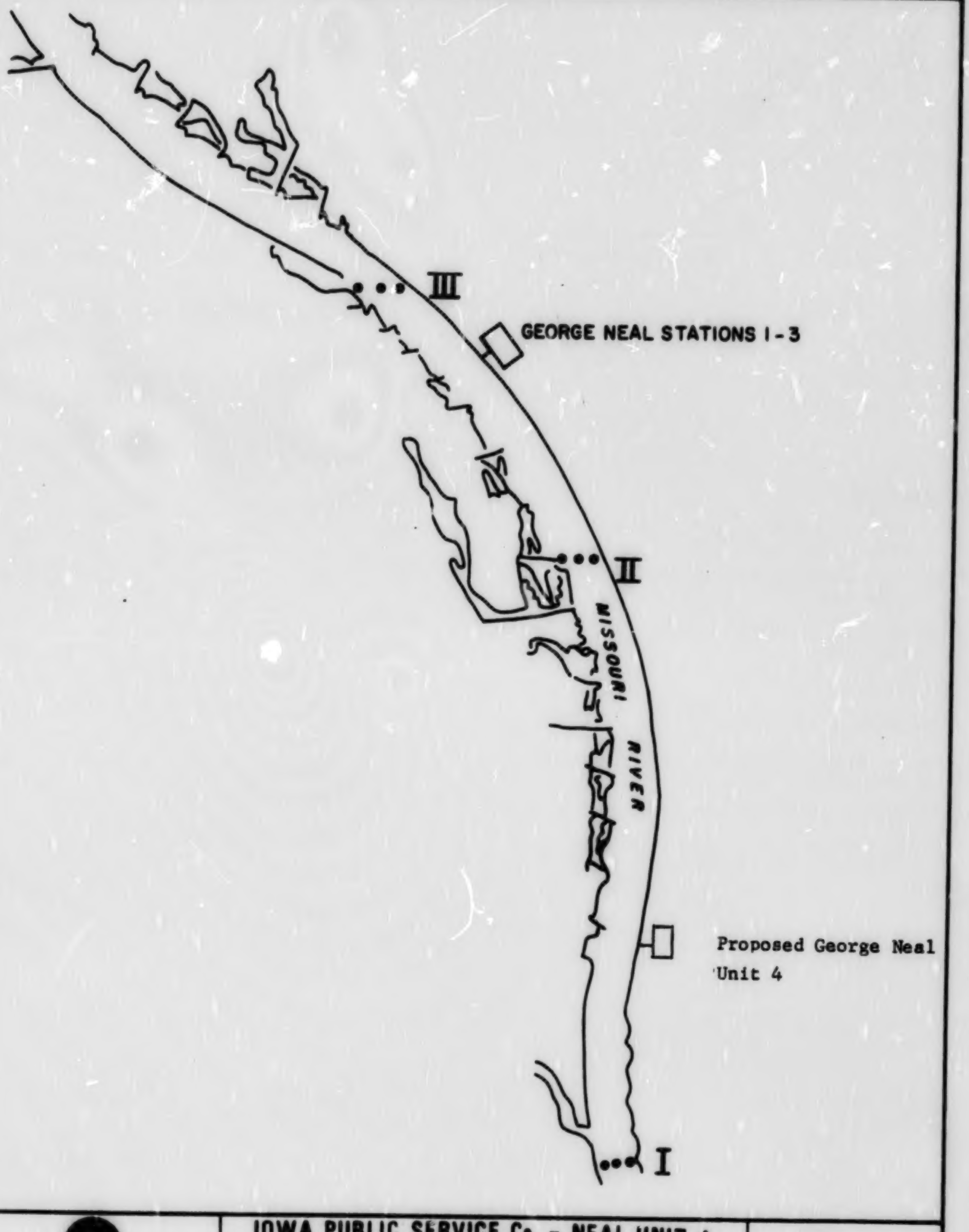
- Transect I - 14,100 feet (2.67 miles) below Neal Units 10-3;
- Transect II - 3,000 feet below Neal Units 1-3;
- Transect III - 1,380 feet above Neal Units 1-3.

Since then, a new series of eight stations, spaced linearly along the Iowa shore of the Missouri river, has been established for these purposes (Exhibit III-C-3). Transect I was located 5,700 feet below the proposed Neal Unit 4, whereas, Station 1 of the new series of stations is approximately 4,785 feet above the Neal Unit 4 site. Artificial substrate stations are located from Browers Bend (just above Neal Units 1-3) to Snyder Bend (just below Neal Unit 4), and fisheries seining stations extend to Unit 4. Data taken from the stretch of the Missouri River from Brower Bend to Snyder Bend are considered representative to evaluate the proposed Neal station expansion.

Data presented here are essentially restricted to a nineteen month period from May 1973 to December 1975. This corresponds to the time when new stations were designated for water quality and plankton monitoring. However, limited use is made of water quality data gathered at Transect I, from August 1971 through April 1973. Fisheries data are included in their entirety. Detailed data tabulations for Transects I-III, and additional benthic invertebrate (substrate) data are given by Baldwin and Hey[13] and Hey and Baldwin[14]

a. Water Quality

The 1973-1974 monitoring program documented bimonthly changes in temperature, dissolved oxygen (DO), pH, total and orthophosphate, ammonia nitrogen, nitrate nitrogen, chemical oxygen demand (COD), turbidity, and total, dissolved, suspended, and volatile solids. In addition, total and fecal coliform, and fecal streptococci were measured at monthly intervals. In the following discussion only data collected at Stations 1 and 8 (see


III
GEORGE NEAL STATIONS 1-3
II
MISSOURI RIVER
Proposed George Neal Unit 4
I

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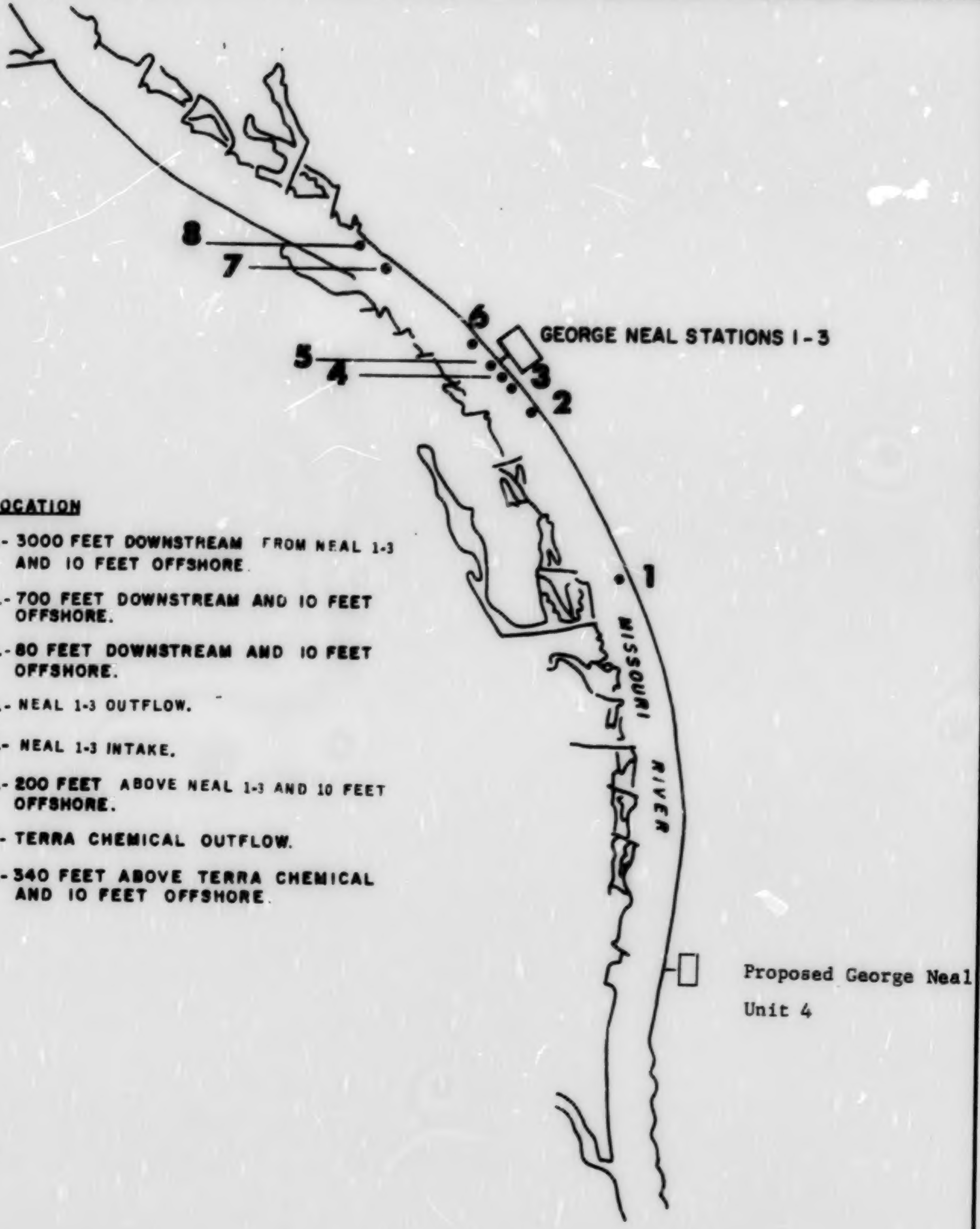
IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

WATER QUALITY AND PLANKTON SAMPLING STATIONS, JULY 1971 - APRIL 1973

EXHIBIT III-C-2

DATE: SCALE:


8
7
6
GEORGE NEAL STATIONS 1-3
5
4
3
2
1
MISSOURI
RIVER
Proposed George Neal
Unit 4

LOCATION

1.- 3000 FEET DOWNSTREAM FROM NEAL 1-3 AND 10 FEET OFFSHORE.
2.- 700 FEET DOWNSTREAM AND 10 FEET OFFSHORE.
3.- 80 FEET DOWNSTREAM AND 10 FEET OFFSHORE.
4.- NEAL 1-3 OUTFLOW.
5.- NEAL 1-3 INTAKE.
6.- 200 FEET ABOVE NEAL 1-3 AND 10 FEET OFFSHORE.
7.- TERRA CHEMICAL OUTFLOW.
8.- 340 FEET ABOVE TERRA CHEMICAL AND 10 FEET OFFSHORE.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

WATER QUALITY AND PLANKTON
SAMPLING STATIONS, MAY 1973 - PRESENT

DATE: SCALE:

EXHIBIT
III-C-3

Exhibit III-C-3), will be considered. Station 1 is located approximately 3000 feet downstream from Neal Unit 3 and represents ambient conditions for Neal Unit 4.

As water quality at Station 1 is influenced by inputs from the Port Neal Industrial area, a statistical comparison was made between Stations 1 and 8 to determine if the Missouri River water quality is being affected by these inputs. The results are summarized in Table III-C-2.

The comparisons were made using the "t" statistic as applied to paired variables. This technique substantially increases the sensitivity of the test in that eliminates the large variability in the raw data resulting from seasonal and short-term effects, e.g. flow. To be strictly valid, the samples would have to have been obtained allowing for the time travel between stations. As this was not done, the statistical analysis should be interpreted as only indicating possible differences between stations. The levels of ammonia, nitrogen, total solids and chemical oxygen demand (COD) were significantly greater at Station 1 than at Station 8. The increases most probably result from discharges from Station 7. They were observed to have high levels of ammonia-nitrogen, up to 200 mg/l; TDS, up to 4000 mg/l; and COD, up to 240 mg/l. Phosphate was significantly greater at Station 8; the reason not apparent.

i. Existing Water Quality - Neal Unit 4

Station 1 was selected as best representing the ambient conditions for Neal Unit 4. The result of two years of water quality sampling and analysis is summarized in Table III-C-3 and discussed in detail in the following sections.

pH

The pH levels observed during the study period are presented in Exhibit III-C-4. Most of the samples were slightly alkaline, in the pH range 8.2 to 8.8. The relatively low pHs, 7.6 to 8.0, recorded during the colder months, November 1973 through April 1974, most probably resulted from subsurface releases from the Gavins Point dam. These releases would be expected to have rather high CO_2 concentrations, which would depress the pH levels.

Alkalinity and Hardness

As shown in Table III-C-3, alkalinity and hardness levels in the Missouri River are high. The mean total alkalinity and total hardness concentrations were 167 and 250 mg/l, respectively.

Parameter	Mean Difference (1-8)	Standard Deviation	Confidence Interval (95%)
pH (Std Units)	0.005	0.131	+/-0.034
Dissolved Oxygen (mg/l)	-0.085	0.346	+/-0.104
Nutrients			
Ortho-Phosphate (mg/l)	-0.02*	0.010	+/-0.003
Total Phosphate (mg/l)	0.005	0.020	+/-0.006
Ammonia (mg/l-N)	0.116*	0.209	+/-0.063
Nitrate (mg/l-N)	-0.001	0.122	+/-0.037
Solids			
Total (mg/l)	9.50*	18.9	+/-5.76
Total Suspended (mg/l)	8.45	32.0	+/-9.75
Dissolved (mg/l)	5.66	20.6	+/-6.26
Total Volatile (mg/l)	1.04	17.6	+/-5.38
Turbidity (FTU)	-1.81	6.21	+/-1.87
Chemical Oxygen Demand (mg/l)	1.86*	5.12	+/-1.56

*The difference between stations is significant at the 95 percent confidence level.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

A COMPARISON OF WATER QUALITY AT
STATIONS 1 AND 8

DATE:
SCALE:

TABLE
III-C-2

Parameter	Range		Mean	Standard Deviation
	Min	Max		
pH (Std. Unit)	7.6	9.0	8.2	-
Temperature (^{o} C)	-1.0	26.8	12.3	-
Dissolved Oxygen (mg/1)	6.9	15.4	10.9	-
Percent Saturation	84	122	98	5.6
Alkalinity (mg/1)				
Total	148	188	167	12.3
Phenolphthaleine	0	12	3.7	4.0
Total Hardness (mg/1)	196	304	250	23.6
BOD	1.4	9.0	4.2	2.8
Total Iron	1.09	31.7	5.7	9.8
Nutrients				
Ortho - PO_4 (mg/1)	0.00	0.11	0.032	0.022
Total - PO_4 (mg/1)	0.01	0.14	0.050	0.031
NH_3 - N (mg/1)	0.00	1.50	0.236	0.270
NO_3 - N (mg/1)	0.06	1.14	0.327	0.296
Solids				
Total (mg/1)	491	691	549	32.9

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

SUMMARY OF WATER QUALITY AT STATION 1

DATE:

SCALE:

TABLE
III-C-3

Parameter	Range		Mean	Standard Deviation
	Min	Max		
Total suspended (mg/1)	11	130	55.3	18.1
Dissolved (mg/1)	432	613	493	28.3
Total Volatile (mg/1)	42	150	69.7	16.9
Turbidity (FTU)	9	39	23.9	8.1
COD (mg/1)	5.6	56.5	13.2	6.8

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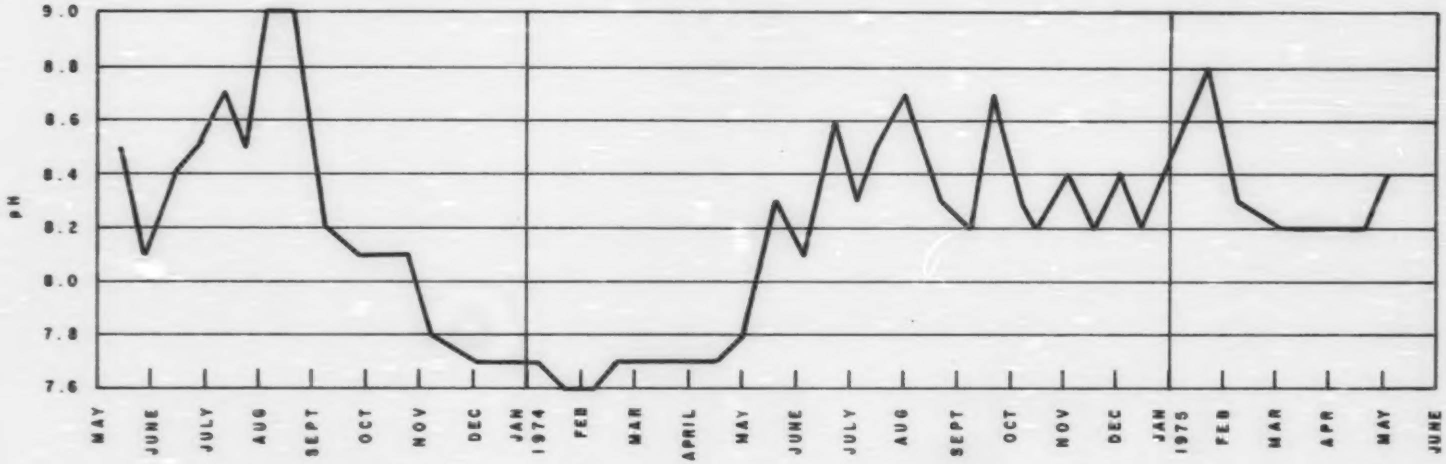
IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

SUMMARY OF WATER QUALITY AT STATION 1

DATE:

SCALE:

TABLE
III-C-3
(cont'd)



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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

SEMI-MONTHLY LEVELS OF pH AT STATION 1

DATE:

SCALE:

EXHIBIT

III-C-4

Iron

The concentrations of total iron reported are rather high for a surface water, up to 32 mg/l with a mean of 5.7. The iron content is most probably associated with suspended sediment in the form of $Fe2(OH)3$.

Dissolved Oxygen

Dissolved oxygen (DO) levels at Station 1 are relatively high and exhibit the normal seasonal variation for DO concentrations, as shown in Exhibit III-C-5. Because of the seasonal variation in DO concentrations, the percent saturation is generally a more useful parameter for assessing the oxygen regimen of a stream. As shown in Exhibit III-C-5 the percent DO saturation levels are satisfactory. The seasonal variation in saturation levels results from the higher rates of Biological Oxygen Demand (BOD), Nitrification Oxygen Demand (NOD), and benthal oxygen demand during the warmer months. Several observations exceeding saturation were noted during the colder months. This may have resulted from the entrapment of small air bubbles, resulting from the highly turbulent flow of the Missouri River.

Temperature

Temperature variation is given in Exhibit III-C-6. Temperatures showed the normal seasonal variation, with maximums occuring during July and August and minimums during January and February. During the two-year study, the average temperature was 12.3° C with a maximum of 26.8° C and a minimum of -1° C.

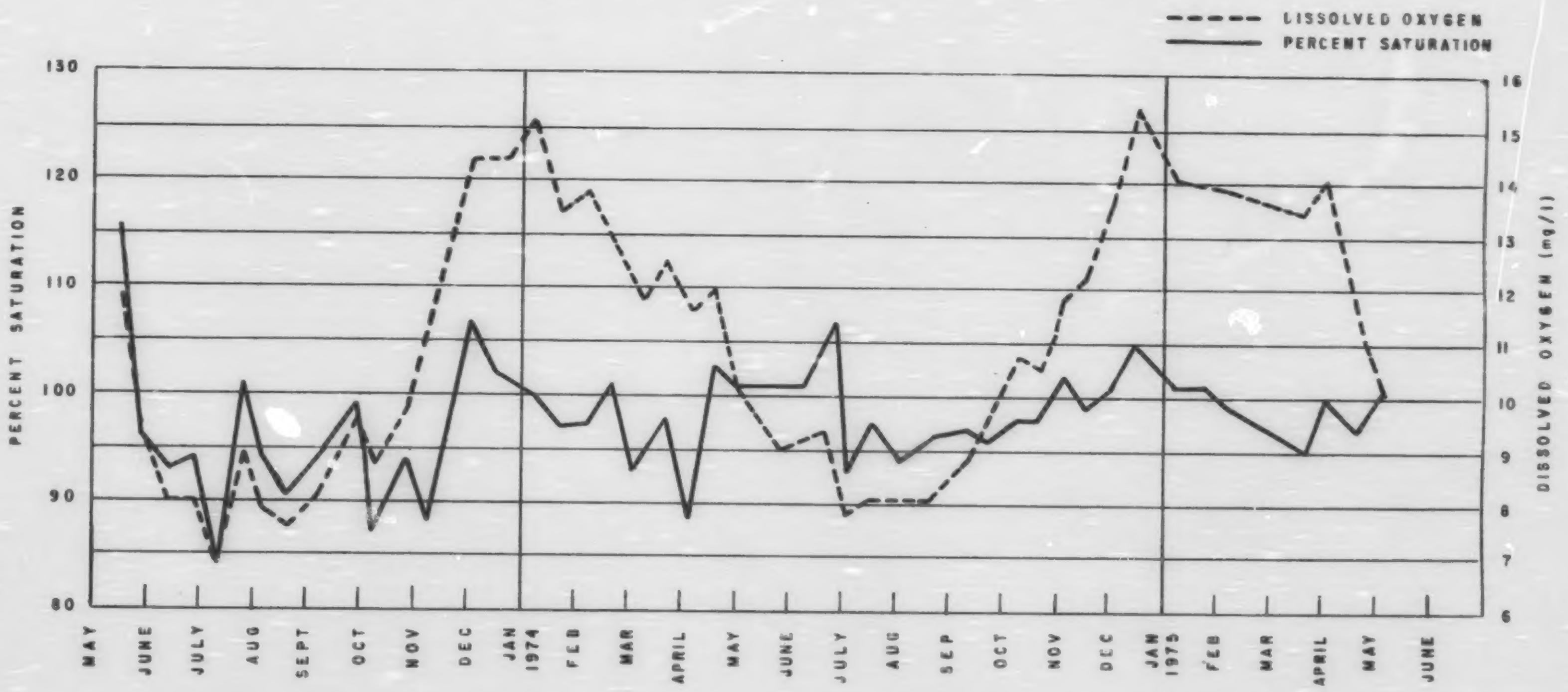
Nutrients

The levels of ammonia and nitrate nitrogen, and phosphates, both total and ortho, were determined at semimonthly intervals over the study period. Exhibit III-C-7 presents the concentrations of $NH3$-N, $NO3$-N and total $PO4$ at Station 1. Nutrient levels exhibited seasonal fluctuations, with minimum levels observed during the late summer, July through September. During the winter months the nutrient levels remained relatively constant; sharp increases in nutrient levels were noted during the spring.

The decreased nutrient levels during the summer most probably result from increased biological activity, especially algae, while sharp increases in the spring probably result from the application of fertilizers during the planting season.

Solids and Turbidity

Suspended solids concentration in the Missouri River are moderately high, a mean of 55.3 mg/l, as would be expected of a rapidly flowing, highly turbulent river. In general, levels tended to be somewhat lower during the low flow stages, non-



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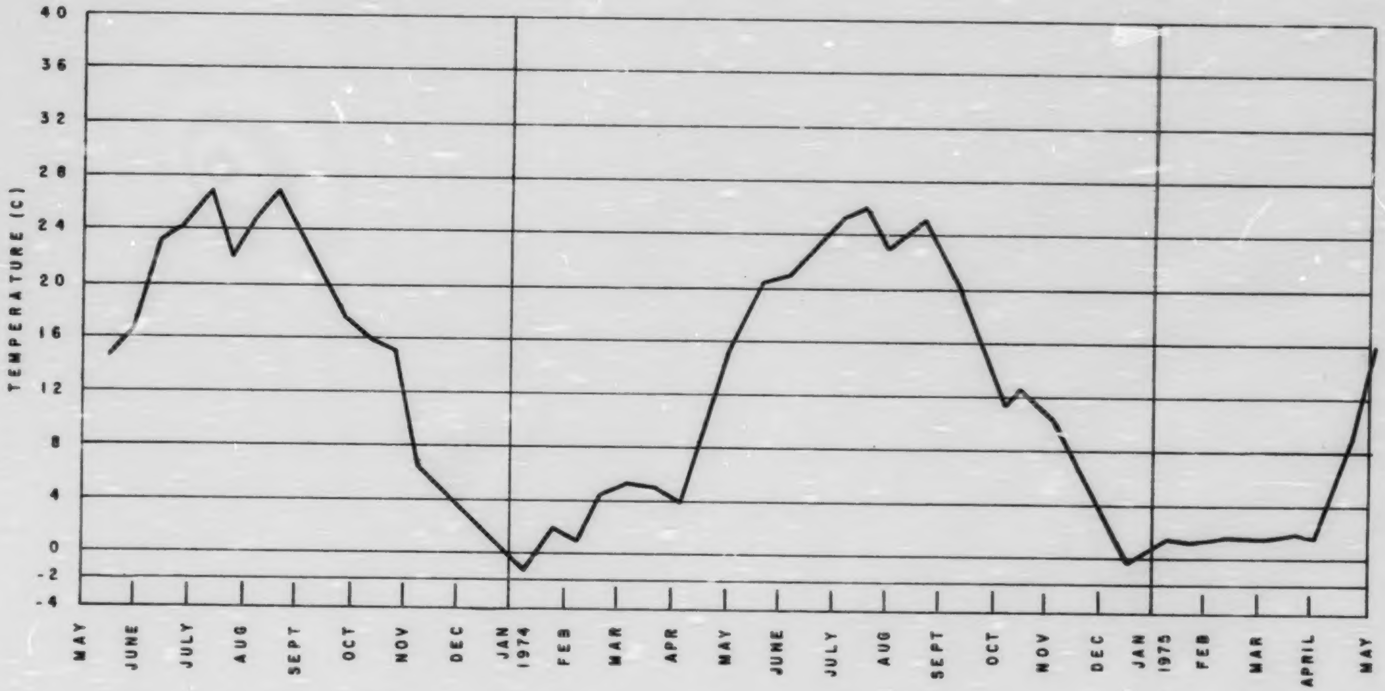
IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

SEMI-MONTHLY LEVELS OF DISSOLVED OXYGEN AND
PERCENT SATURATION AT STATION 1

DATE:

SCALE:

EXHIBIT
III-C-5



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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

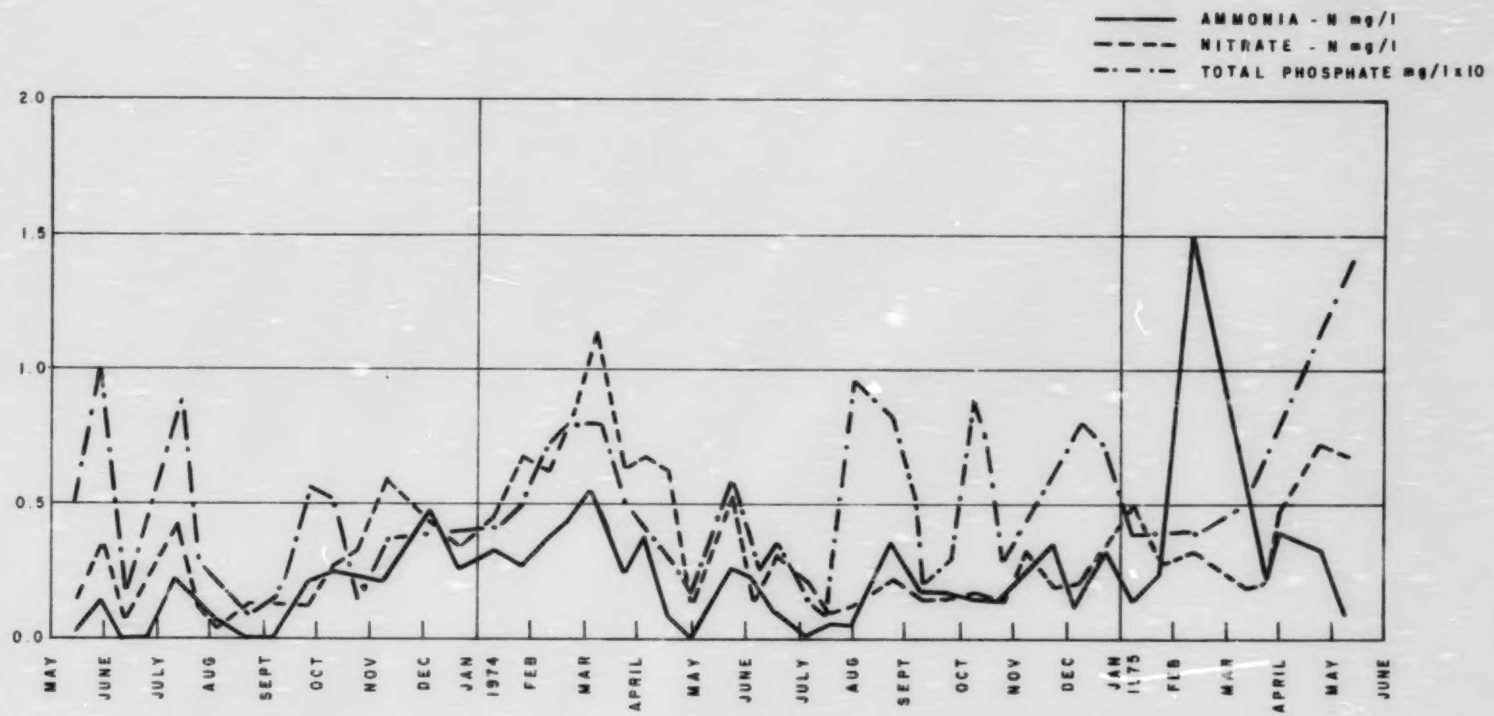
SEMI-MONTHLY LEVELS OF TEMPERATURE AT STATION 1

DATE:

SCALE:

EXHIBIT

III-C-6



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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

SEMI-MONTHLY NUTRIENT LEVELS AT STATION 1

DATE:

SCALE:

EXHIBIT

III-C-7

navigation season, with maximum levels associated with rainfall events. Turbidity levels generally paralleled the suspended solids. The average turbidity at Station 1 was 23.9 Formazin Turbidity Units (equivalent to Jackson Turbidity Units).

Total dissolved solids levels remained relatively constant, varying between 400 and 600 mg/l.

Chemical Oxygen Demand (COD)

The COD levels at Station 1 varied between 5.6 and 56.5 mg/l with a mean of 13.2 mg/1. The COD levels measured are typical of a slightly polluted environment.

Biochemical Oxygen Demand (BOD)

BOD levels with a mean of 4.2 are characteristic of slightly polluted streams. The mean COD to BOD ratio is 3:1, and indicates the organic pollutants in the stream are readily degradable.

Bacterial Indicators of Pollution

Table III-C-4 summarizes the total coliform (TC), fecal coliform (FC), fecal streptococci (FS), and FC/FS ratio from Station 1. The means presented are geometric means, $(X_1 \cdot X_2 \ldots X_n)^{1/n}$. FC counts were high at Station 1, the mean number per 100 ml exceeds the Iowa water quality criteria for the Missouri River by a factor greater than two.

ii. Summary

The water quality in the vicinity of the Neal station remains rather high considering the substantial pollutional loads from the Sioux City area, both sewage and stockyard wastes. The high flow rates, flow velocity, and resulting turbulence combine to provide the Missouri River with an extremely high capacity for self purification. This is evidenced by high dissolved oxygen percent saturation levels even with substantial BOD loadings from the Sioux City region.

From a water quality standpoint the most significant consideration for the Missouri below Sioux city is the high FC and FS levels which results from the discharge of inadequately treated sewage and animal wastes. The high levels indicate a potentially serious health hazard to swimmers in water bodies fed from the Missouri.

b. Algae

Detailed data of abundance and distribution of phytoplankton genera found in the vicinity of the George Neal Station Units 1-4 from May 1973 through April 1974 and from June 1974 to December 1975, are presented in Appendix Table A-III-C-1. Exhibit III-C-8

	Geometric Mean per 100 ml	Maximum per 100 ml	Minimum per 100 ml
Total Coliform	31,700	146,000	2,600
Fecal Coliform	4,600	103,000	180
Fecal Strepto- cocci	920	17,000	140
FC/FS Ratio	5.0	98	0.09

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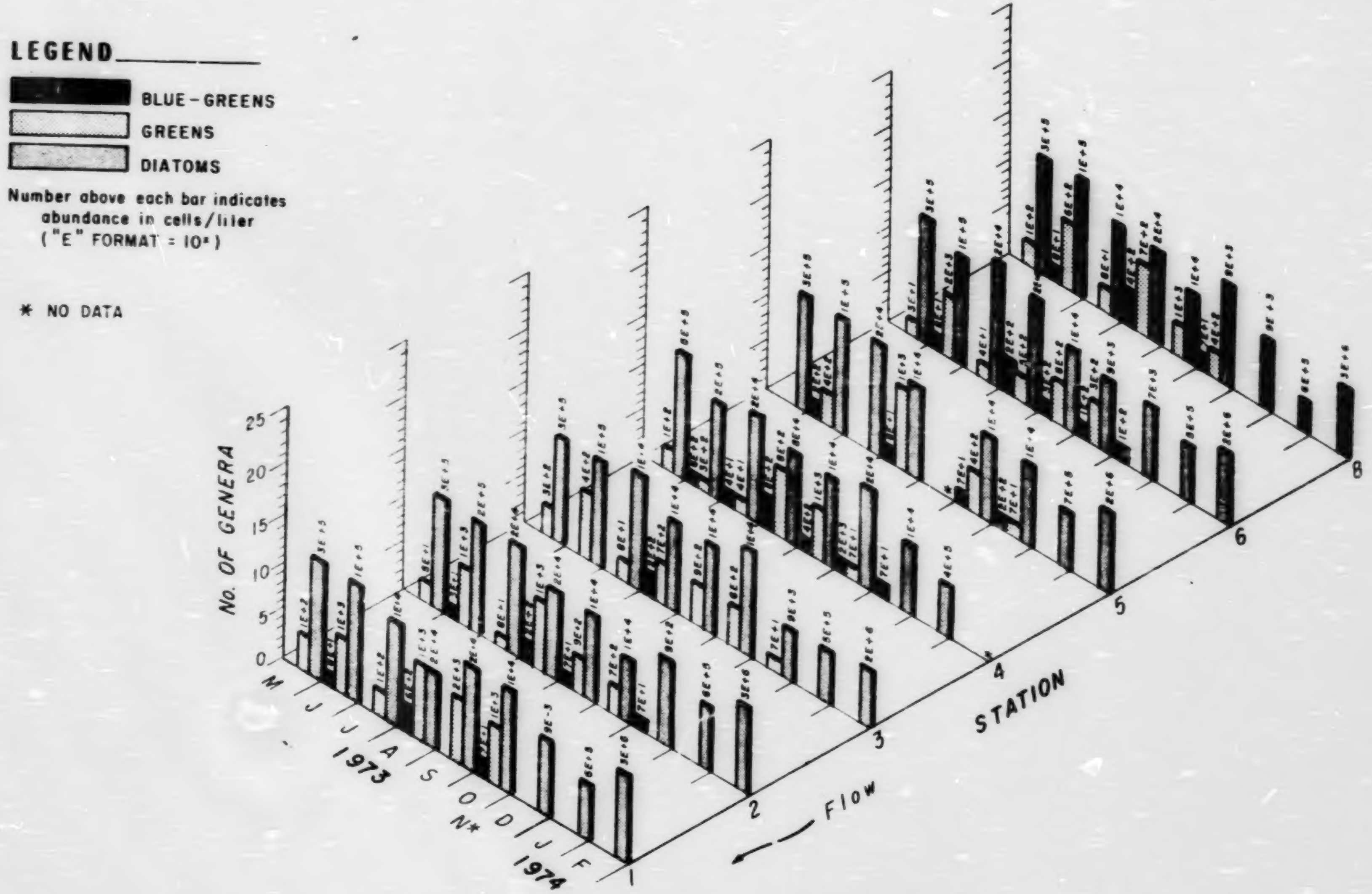
IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

MONTHLY BACTERIAL COUNTS STATION 1

DATE:

SCALE:

TABLE
III-C-4



IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

DIVERSITY (NUMBER OF GENERA) AND ABUNDANCE
(NUMBER OF INDIVIDUALS) OF PHYTOPLANKTON, STATIONS 1-8
MISSOURI RIVER, IOWA

DATE:

SCALE:

EXHIBIT
III-C-8

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represents a consolidation of the data from May 1973 to February 1974.

The data indicate an overwhelming year-round dominance by diatoms. The most abundant genera observed during the study were Asterionella, dominant from January or February through June or July, and Cyclotella, usually dominant from July or August through December or January. However, in the November and December 1975 samples, Asterionella was dominant while in the October 1975 sample Nitzchia was dominant. Both Asterionella and Cyclotella are euplanktonic. Other important diatoms included Fragillaria, Melosira, Nitzchia and Navicula. Nitzchia and Navicula are benthic and were more abundant at Station 4 on various dates (see Appendix A-III-C-A). Abundance of other benthic diatoms, (Diatoma, Gomphonema, Synedra) was usually independent of levels of Navicula and Nitzchia. Kite diagrams showing temporal changes in the relative contribution of Asterionella, Cyclotella, Nitzchia, and Navicula to the total sample composition (May 1973 to May 1974) are presented in Appendix A-III-C-A.

Green algae reached their peak abundances in late summer 1973 and during June 1974 and June 1975. Distribution of green algae was variable (Exhibit III-C-8).

Blue-green algae were present in low numbers, usually 2000 cells/liter and were generally absent in plankton samples in winter and early spring. Blue-greens, as a group, grow optimally in higher temperatures than green algae and diatoms.[23] However, there appeared to be no significant differences in their abundances among the stations sampled, although the May 1973 to May 1974 data showed small increases in blue-green numbers observed at Station 4. Commonly sampled genera of blue-green algae included Oscillatoria, Spirulina, Anacystis and Stichosiphon.

Similarities and dissimilarities in the composition of the plankton community among the seven stations are apparent when faunal affinity indices are used. Sanders' [24] index of affinity was used to produce trellis diagrams for each sampling date from May 1973 to April 1974 (Appendix Exhibits A-III-C-1 through 11). Appendix Exhibits A-III-C-2 and 4 effectively illustrate, with a single number, the sample differences. The dominance of samples taken in June at Station 4 by Navicula and Nitzchia, and of samples taken in August, by Nitzchia, is reflected in low similarities between that station and others sampled. Numbers of Asterionella and Cyclotella which dominated the other samples on a percentage basis, were approximately the same for all stations (with the single exception of Asterionella at Station 4, in June 1973).

Differences in levels of abundance of key species from May 1973 to February 1974 were also reflected in dendrograms, or tree diagrams depicting station similarities. These are shown in

Appendix Exhibits A-III-C-12 to 20, and were formed by regrouping stations on the basis of a general similarity coefficient given by Gower.[26] Differences in samples taken at Station 4 stand out distinctly in May, June, July, August and October (Appendix Exhibits A-III-C-12 to 15 and 17), when levels of similarity with respect to other stations were between only 0.30 and 0.40 on a scale of 1.00.

Dendrograms based simply on the presence or absence of genera convey yet a different picture (Appendix Exhibits A-III-C-21 to 29). No consistent community patterns emerge in Appendix Exhibits A-III-C-21 through 28.

Two qualitative "periphyton" surveys (as they have come to be called) were conducted in the Port Neal area in 1973. In June 1973, rocks were sampled upstream and downstream of Neal Units 1 and 2 discharge. In August 1973, rocks were sampled upstream of, downstream of, and on the discharge structure. Results are given in Appendix Tables A-III-C-A-1 and 2. Station differences in green algae were essentially opposite for the two sampling dates, and the presence of blue-greens at and below the discharge was noted in August. Genera found were comparable to those reported in the Missouri River near Brownville, Nebraska,[21] where communities colonizing glass panels were generally dominated by Nitzchia and Navicula.

c. Macrophytes

In the channelized sections of the Missouri River, few if any macrophytes exist because of flow manipulation and shifting substrate. However, in the backwater areas during the lower river levels of 1973 and 1974, the relative abundance of Phragmites communis, Polygonum and Typha spp. increased. Sedges and rushes became more important, and cottonwood and willows established themselves on exposed sandbars.[17] In 1975, during the high river flows, this vegetation was submerged.

d. Zooplankton

According to phytoplankton and zooplankton samples collected in the Missouri River from June 1973 through December 1975, a copepod, Cyclops, was the dominant animal, although Diaptomus (another copepod) and Daphnia (a cladoceran) occurred regularly in the summer of 1973. Daphnia was by far the dominant genus collected in drift net samples. Organisms such as mites (Hydracarina) and hydroids (Hydra) occurred with low, but equal frequency. Rotifers, which have been described as nearly always dominating the riverine zooplankton[16], were notably absent (Appendix Table A-III-C-1.) This was probably due to the fact that size of the drift net (243 u) was too large to trap rotifers (according to Pennak[55], rotifers range from 100-500 u long). During June and July of 1975 when zooplankton samples were made by towing a metered Wisconsin net made of 76 u mesh nitex, samples included both protozoa and rotifers. The ten species of rotifers collected were evenly distributed at the three sites sampled. *Difflugia* was the most abundant protozoan collected. Copepods were present in all samples in June 1975, but their abundance, and that of the rotifers, decreased as the summer progressed. The Cladocera were less numerous than the Copepoda, and were represented by *Bosmina* and *Daphnia*.

e. Macroinvertebrates

i. Drift

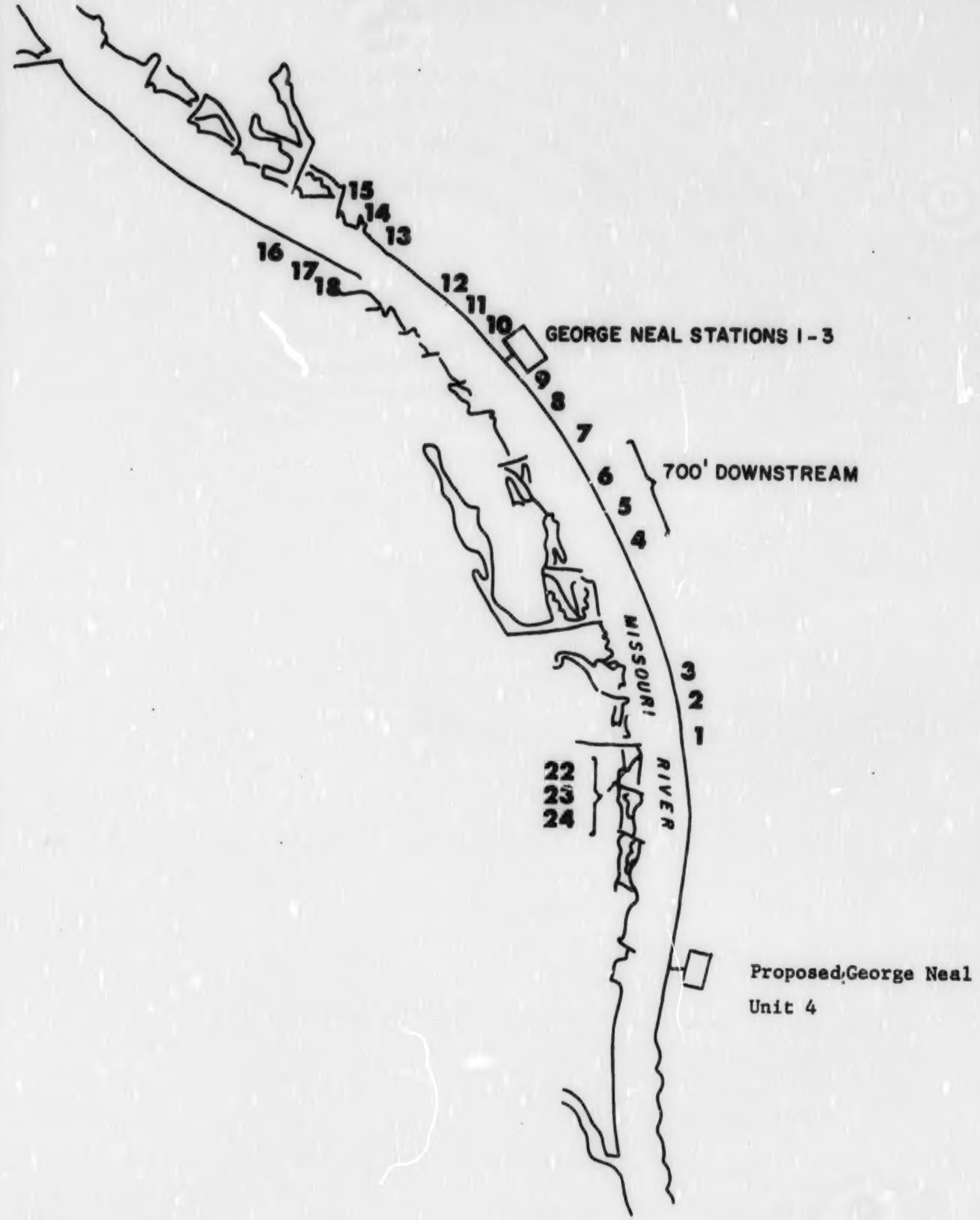
Drift studies in the Missouri River have been conducted by Russell[1], Holz[33], and Morris *et al.*[2]. Dipterans were found by Holz[33] and Russell[1] to be the dominant insects near the Iowa/South Dakota line. Hey and Baldwin[15], in the present series of investigations (Appendix Table A-III-C-2), also found that Diptera was the most abundant order of insect collected. Ephemeroptera (mayflies) and Diptera comprised approximately equal percentages of the insect drift in studies by Morris *et al*[2], however, mayflies were not abundant in drift at the Port Neal site. Morris *et al*[2] found greater crustacean biomass in the drift from unchannelized portions of the Missouri River, but biomass of insects was higher in the drift in channelized areas.

ii. Artificial Substrates

Artificial substrates were used to collect macroinvertebrate samples. The data collected in the vicinity of the George Neal Stations1-4 during April 1973 to November 1975 are given in Appendix Table A-III-C-3. Aquatic macroinvertebrates have classically been used as indicators of organic pollution.[30, 35, 36] The kinds of invertebrates colonizing substrates in the Port Neal area of the Missouri River were generally the facultative and/or intolerant groups[30], as opposed to the more pollution tolerant forms such as tubificids, and certain snails and beetles.

Dominant macroinvertebrates at Port Neal were midges (*Tendipes*), caddis flies (order: Trichoptera), mayflies (order: Ephemeroptera), planarians (phylum: Turbellaria), and hydras (phylum: Hydrazoa), Nematodes (roundworms), stoneflies (order: Plecoptera), and sow bugs (*Asellus*; class: Crustacea), were occasionally abundant. Overall, the class Insecta, and primarily the orders Trichoptera, Ephemeroptera, and Diptera were dominant. Their numbers, expressed as medians over all stations sampled (Exhibit III-C-9), are presented in Exhibit III-C-10 for April 1973 to October 1973.

There was considerable variability in distribution and abundance of invertebrates among individual samplers. This variability is illustrated in Exhibit III-C-11 (April 1973 to October 1973) for insects, as well as in trellis diagrams of indices of affinity using all animals sampled (Appendix Exhibits A-III-C-30 to 36), April 1973 to November 1973. At times,


15
14
13
16
17
18
12
11
10
GEORGE NEAL STATIONS I-3
9
8
7
700' DOWNSTREAM
6
5
4
MISSOURI
RIVER
3
2
1
22
23
24
Proposed George Neal
Unit 4

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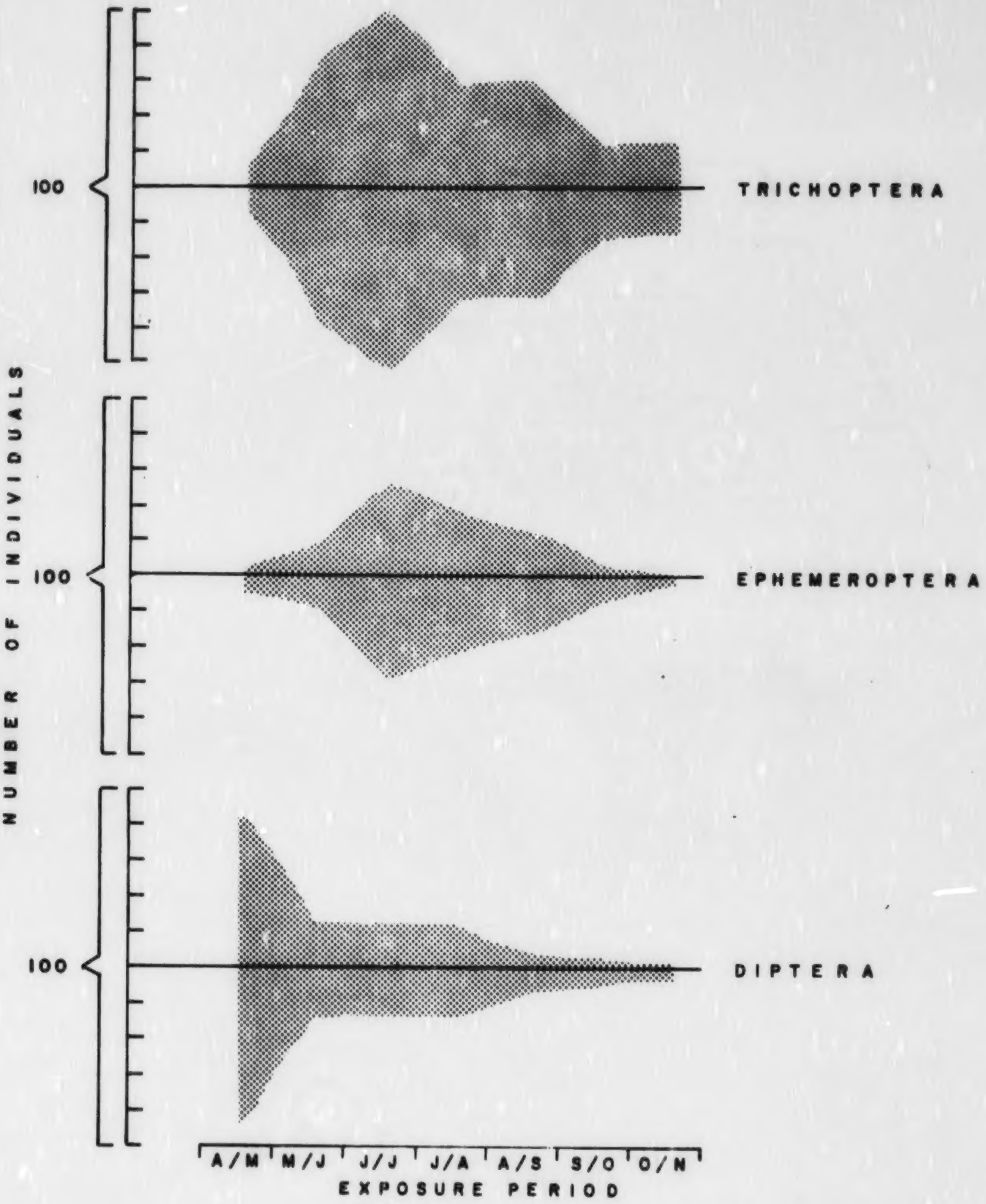
IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

ARTIFICIAL SUBSTRATE SAMPLER STATIONS, 1973

DATE: SCALE:

EXHIBIT
III-C-9



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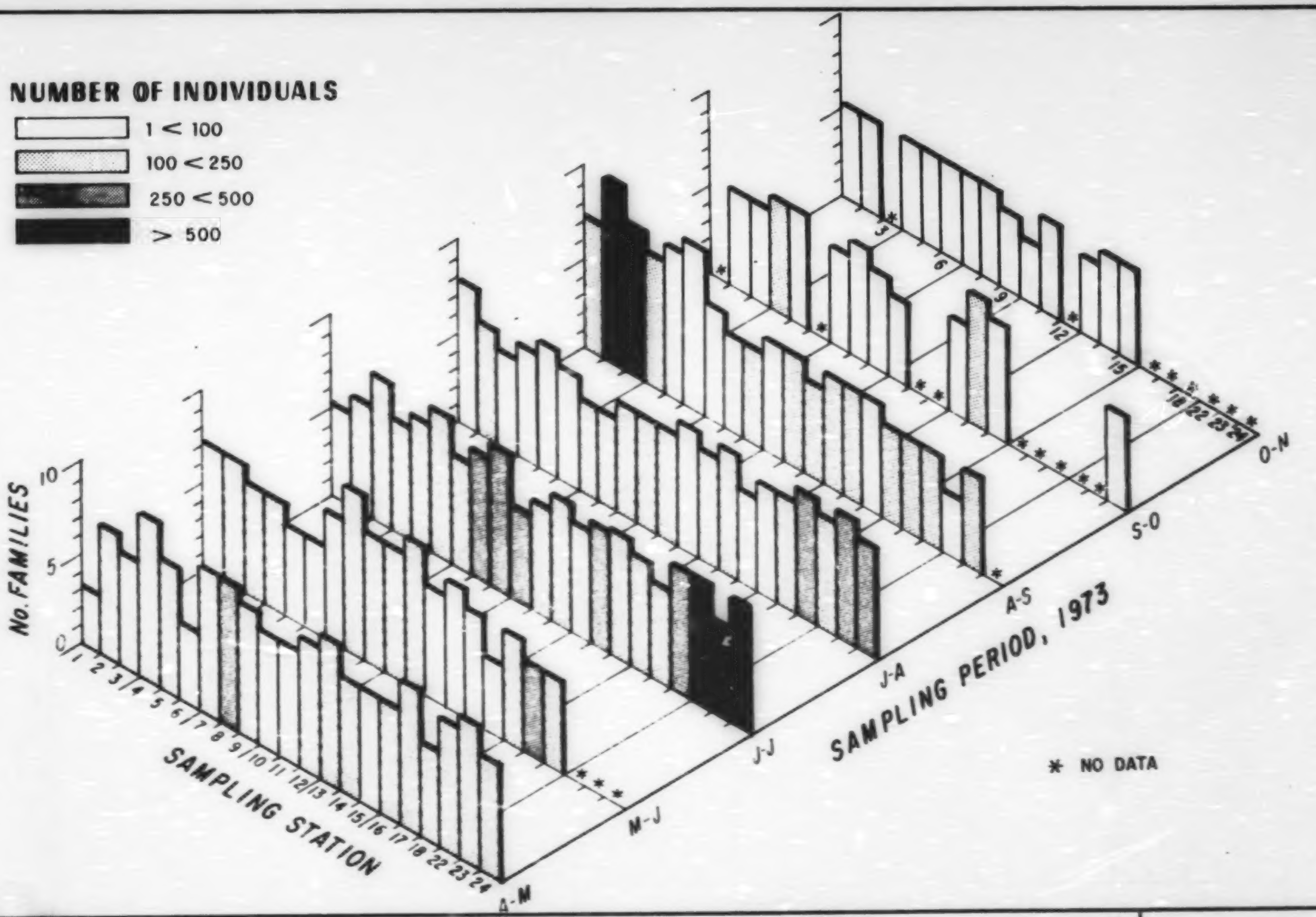
IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

MONTHLY MEDIAN ABUNDANCE OF TRICHOPTERA (CADDISFLIES), EPHEMEROPTERA (MAYFLIES), AND DIPTERA (MIDGES), OVER ALL ARTIFICIAL SUBSTRATE STATIONS, MISSOURI RIVER, IOWA AND NEBRASKA

DATE: SCALE:

EXHIBIT
III-C-10



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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

DIVERSITY (NUMBER OF FAMILIES) AND ABUNDANCE (NUMBER OF INDIVIDUALS)
OF AQUATIC INSECTS COLLECTED ON ARTIFICIAL SUBSTRATES
MISSOURI RIVER, IOWA

DATE:

SCALE:

EXHIBIT III-C-11

abundance of insects was higher downstream (Stations 1, 2, 3 and 22, 23, 24) than upstream (Exhibit III-C-11). However, no consistent patterns emerged, and the data failed to indicate a deleterious effect on aquatic insect communities due to operation of Neal Units 1 and 2 (primarily thermal, see Table III-C-5 for example). Upon closer inspection of data given in Appendix Table A-III-C-3, certain trends however do, appear; i.e., caddis flies and mayflies were often more abundant in semiprotected areas along the Nebraska shore (Stations 16, 17, 18, and 22, 23, 24) than they were on the Iowa shore. Also, the crustacean *Asellus* (sow bug) had a tendency to be more abundant at Stations 13 to 15, compared to other stations on the Iowa site. Other animals showed wide spatial variability. The correlation between drift organisms and organisms populating artificial substrates was not obvious, although Diptera were commonly numerous in both sets of samples.

f. Fish

Fish species indigenous to the Missouri River have been described in a general way in Section III-C-1, and commercial data for 1972-1975 have been presented. The community is dominated by catfish, carp, and carpsucker with additional species such as northern pike, sauger, buffalo, gizzard shad, and others enhancing the diversity of the system. Channelization has been cited as the major cause of decreased productivity in the Missouri River. Existing species are dependent upon wing dike habitats, upstream areas (in particular below the Gavins Point Dam), cutoffs, and seasonally-inundated flood plains for spawning and recruitment.

Often, spawning of riverine fish is accompanied by a general upstream movement, and significant losses to populations within the normal adult "home range" are thus averted.[16] This may be true of carp, carpsuckers, catfish, minnows, and others, although specific data are not available. Sauger may move upstream to spawn in the vicinity of Gavins Point Dam, and some sauger are probably recruited from Lewis and Clark Lake above the dam.[38] Recruitment from Lewis and Clark Lake may also be expected for carp, carpsucker, channel catfish, freshwater drum, walleye, and shiners.[38] Intrastream movements may also normally occur for reasons other than spawning. For example, up and downstream movement of channel catfish has been well documented[39], [40], [41] and it has been suggested that at any given time both sedentary and mobile groups may exist within the population.[16]

Abundance of fishes in the Missouri River was studied by bag seining, electrofishing, trammel netting, and gill netting. Common and scientific names of fish species collected at Port Neal, are given in Table III-C-6. Carp, river carpsucker, goldeye and gizzard shad were the most common species found in the greatest numbers in all habitats present in the study area.

Sampling Sites:

Depth	#1	#2	#3	#6	#8
Surface	83.1 (1.1)	82.8 (.8)	86.0 (4.0)	82.4 (.4)	82.0 (0.0)
1'	82.8 (.8)	83.3 (1.3)	86.7 (4.7)	82.2 (.2)	81.7 -(.3)
2'	82.8 (.8)	83.3 (1.3)	86.0 (4.0)	82.2 (.2)	82.0 (0.0)
5'	82.9 (.9)	83.5 (1.5)	85.8 (3.8)	82.2 (.2)	82.0 (0.0)
10'	82.8 (.8)	83.5 (1.5)	84.6 (2.6)	82.0* (0.0)	82.0** (0.0)

* depth at bottom 8.8'
** depth at bottom 9.0'

Note: ambient river temperature determined at 4:00 p.m. prior to sampling site-thermal profiles = 82.0°F

Location of Sampling Sites Used in Preoperational Study for Neal III

1 3000 feet downstream from George Neal Station and 10 feet out from shore (same as old Site II-Iowa)

2 700 feet downstream from George Neal Station and 10 feet out from shore (same as Site II-A)

3 80 feet downstream from George Neal Station and 10 feet out from shore

6 200 feet upstream from George Neal Station and 10 feet out from shore

8 approximately 400 feet upstream from the Terra Chemical outflow and 10 feet out from shore

4 Neal Station outflow - not included here

5 Neal Station intake - not included here

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

THERMAL PROFILES
SAMPLING SITES (° F) - JULY 12, 1973

DATE:
SCALE:

TABLE
III-C-5

Common Name	Scientific Name
Bigmouth buffalo	*Ictiobus cyprinellus*
Black bullhead	*Ictaluras melas*
Black crappie	*Pomoxis nigromaculatus*
Bluegill	*Lempomis marochirus*
Blue sucker	*Cycleptus elongatus*
Bullhead Minnow	*Pimephales vigilax*
Burbot	*Lota lota*
Carp	*Cyprinus carpio*
Carpsucker	*Carpiodes carpio*
Channel catfish	*Ictalurus punctatus*
Flathead catfish	*Pylodictus olivaris*
Flathead chub	*Hybopsis gracilis*
Freshwater drum	*Aplodinotus grunniens*
Gizzard shad	*Dorosoma cepedianum*
Goldeye	*Hiodon alosoides*
Green sunfish	*Lepomis cyanellus*
Johnny darter	*Etheostoma nigrum*
Largemouth bass	*Micropterus salmoides*
Longnose gar	*Lepisosteus osseus*
Minnows	*Notropis spp.*
Mirror carp	*Cyprinus carpio*
Mooneye	*Hiodon tergisus*
Northern pike	*Esox lucius*
Orangespotted sunfish	*Lepomis humilus*
Pallid sturgeon	*Scaphirhynchus album*
Plains flathead chub	*Hybopsis gracilis*

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IOWA PUBLIC SERVICE CO. - NEAL UNIT 4

COMMON AND SCIENTIFIC NAMES OF
FISH COLLECTED IN THE PORT NEAL AREA
OF THE MISSOURI RIVER AND ITS BACKWATERS
(SHEET 1 OF 2)

DATE: SCALE:

TABLE
III-C-6

Common Name	Scientific Name
Pumpkinseed	*Lepomis gibbosus*
River Carpsucker	*Carpiodes carpio*
River redhorse	*Moxostoma carinatum*
Sauger	*Stizostedion canadense*
Shorthead redhorse	*Moxostoma macrotepidotum*
Shortnose gar	*Lepisosteus platostomus*
Shovelnose sturgeon	*Scaphirhynchus platyorynchus*
Skipjack herring	*Alosa chrysochloris*
Smallmouth bass	*Micropterus dolomieui*
Smallmouth buffalo	*Ictiobus bubalus*
Stonecat	*Noturus flavus*
Walleye	*Stizostedion vitreum vitreum*
White bass	*Morone chrysops*
White crappie	*Pomoxis annularis*
White sucker	*Catostomus commersoni*
Yellow perch	*Perca flavescens*

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IOWA PUBLIC SERVICE CO. - NEAL UNIT 4

COMMON AND SCIENTIFIC NAMES OF
FISH COLLECTED IN THE PORT NEAL AREA
OF THE MISSOURI RIVER AND ITS BACKWATERS
(SHEET 2 OF 2)

DATE: SCALE:

TABLE
III-C-6
(Cont'd)

Fish species were collected in varying life history stages, depending on the habitat sampled and gear selectivity. For example, bluegills, minnows, johnny darters, crappies, largemouth bass and yellow perch were only collected by bag seining in backwater areas (Exhibit III-C-12). Most of these, and other species collected by seining, were young-of-the-year individuals (Appendix Table A-III-C-4).

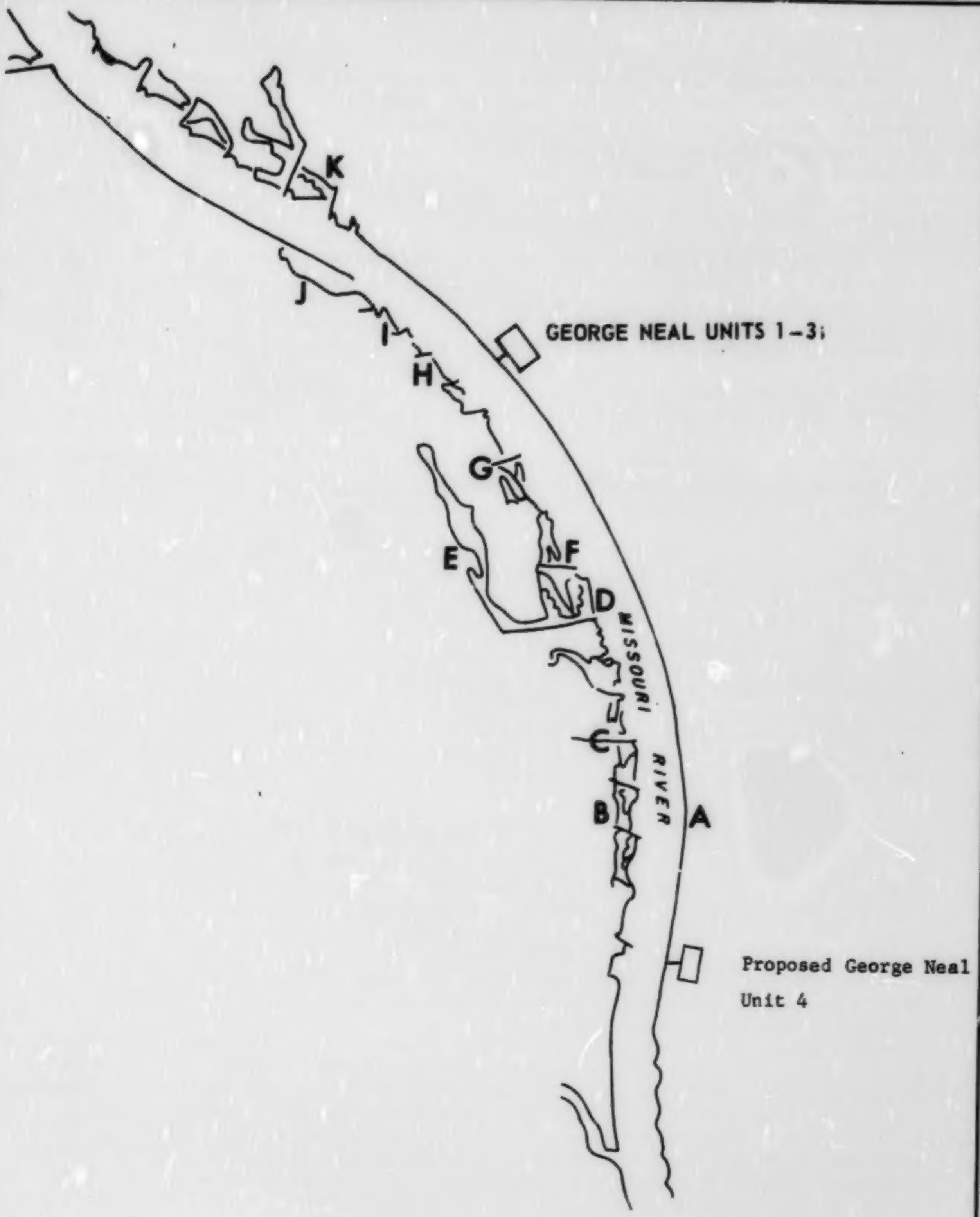
Electrofishing was the most successful sampling method, although it is apparently not effective on channel catfish[32], [42]. The presence of channel catfish was indicated by commercial fisheries data (Section III-C-1) and Neal Units 1, 2 and 3 intake screen impingement data (Section IV-B). A summary of trammel and gill net data for 1971-1975 is given in Table III-C-7, and electrofishing data for areas above and below the present Neal 1 and 2 discharge are given in Table III-C-8. Gammon[42] has shown that carp, carpsucker, and buffalo are attracted to warm water discharge in the Wabash River, Indiana, and a trend toward increased abundance of carp and carpsucker and total number of species in the discharge plume of Neal 1 and 2 has been observed.

The most productive backwaters were sites, D, E, J and K although sites D and F are apparently being filled by riparian owners. In fact, all sites are subject to year-to-year river level fluctuations and often winterkill. Sites F and J in Nebraska, for example, experienced an extensive winterkill in 1973 resulting in the death of many carp, carpsucker, bullhead, freshwater drum, crayfish, and frogs.[15]

Eggs and larvae of the various fish species inhabiting the Missouri River were taken in drift net samples and entrainment (by Neal Units 1 and 2) samples in 1973, 1974, and 1975.

Of 1487 larvae taken in drift and entrainment samples from May through August 1974, 79 percent were drum; 20 percent were minnows; and 1 percent remained unidentified. Of 1,001 larvae collected from May through August 1975, 42 percent were freshwater drum and 57 percent were minnows (Tables III-C-9 and 10).

In comparison of data presented in the Environmental Report for the Fort Calhoun Unit 1 nuclear station located about 65 miles to the south of Neal Unit 4, to the data provided herein, differences in numbers of fish collected are significant. Available literature[19], substantiates these results. Green[19] divided the portion of the Missouri River he studied into four sections. Of these, Section II extends from Sioux City, Iowa to Blair, Nebraska and includes the Neal 4 plat site. Section III extends from Blair, Nebraska to Nebraska City, Nebraska and contains the Ft Calhoun plant site. Section IV extends from Nebraska City, Nebraska to Rulo, Nebraska. He states that "all channelized river sections are not alike because of effects man-made structures have had upon the river. For example, Section II had more oxbow lakes with functional connections to the river


K
J
I
H
G
E
F
D
C
B
A
MISSOURI RIVER
GEORGE NEAL UNITS 1-3
Proposed George Neal Unit 4

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

FISHERIES BACKWATER AND SHORELINE SEINING AREAS (A THROUGH K)

DATE: SCALE:

EXHIBIT III-C-12

October 1971

(2 Trammel Nets - Each Set for 6 Hours)

Species	Number Caught T
Goldeye	2
Gizzard Shad	1
Northern Pike	2
Carp	9
Channel Catfish	1
Carpsuckers	30
Shortnose Gar	2
	47 Total

May 1972

(1 Gill Net - Set for 3 Hours)

Species	Number Caught G
Goldeye	10
Carpsuckers	21
Yellow Perch	1
Northern Redhorse	1
Carp	2
	35 Total

June 1972

(1 Gill Net - Set for 3 Hours)

Species	Number Caught G
Carpsuckers	4
Shortnose Gar	1
	5 Total

August 1972

(3 Gill Nets - 2 Set for 3 Hours Each, 1 Set for 17 Hours
2 Trammel Nets - 1 Set Overnight, 1 Set and Fish were Driven Into It)

Species	Number Caught	
	G	T
Crappie	5	
Gizzard Shad	9	1
Goldeye	3	
Sauger	2	
Shortnose Gar	6	
Carpsucker		30
Channel Catfish		1
Bigmouth		1
	25	33 Totals

Baldwin and Hey[13/] and Hey and Baldwin[14/]

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

SUMMARY OF MISSOURI RIVER TRAMMEL AND GILL
NET DATA, 1971-1975
(SHEET 1 OF 3)

DATE: SCALE:

TABLE
III-C-7

April 1973

(1 Gill Net - Set Overnight; 1 Trammel Net Set Overnight)

Species	Number Caught	
	G	T
Redhorse	2	
Shortnose Gar	1	
Goldeye	2	1
Channel Catfish		1
Carp		1
Totals	5	3

August 1973

(1 Trammel Net Set Overnight)

Species	Number Caught
	T
Carpsucker	13
Channel Catfish	
Gizzard Shad	
Largemouth Buffalo	
Sauger	1
Total	14

July 1974

(1 Trammel Net Set Overnight)

Species	Number Caught
	T
Carpsucker	2
Sauger	
Total	2

October 1974

(2 Gill Nets and 1 Trammel Net, Each Set Overnight)

Species	Number Caught	
	G	T
Channel Cat	1	0
Gizzard Shad	0	2
Goldeye	6	2
Sauger	1	0
Shortnose Gar	0	4
Totals	8	8

Source: Baldwin and Hey[13/] Hey and Baldwin[14/]
Hey and Baldwin[17/][18/]

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

SUMMARY OF MISSOURI RIVER TRAMMEL AND GILL
NET DATA, 1971-1975
(SHEET 2 OF 3)

DATE: SCALE:

TABLE
III-C-7
(Cont'd)

May 1975
(2 Gill Nets and 2 Trammel Nets, Each Set Overnight)

Species	Number Caught	
	G	T
Bluesucker	3	0
Carp	0	2
Carpsucker	1	3
Channel Catfish	1	0
Goldeye	10	10
River Redhorse	1	1
Shortnose Gar	2	1
Sauger	1	0
	19	17 Totals

July 1975
(2 Gill Nets and 2 Trammel Nets, Each Set Overnight)

Species	Number Caught	
	G	T
Bigmouth Buffalo	0	2
Black Crappie	0	3
Carp	2	3
Carpsucker	4	20
Channel Catfish	0	5
Freshwater Drum	0	2
Gizzard Shad	0	1
Goldeye	6	26
Longnose Gar	1	0
Shorthead Redhorse	0	6
Shortnose Gar	5	0
Smallmouth Buffalo	0	4
White Crappie	1	1
	19	73 Totals

October 1975
(2 Gill Nets and 4 Trammel Nets, Each Set Overnight)

Species	Number Caught	
	G	T
Black Bullhead	0	2
Carp	1	5
Carpsucker	2	17
Channel Catfish	0	1
Gizzard Shad	2	0
Goldeye	4	30
Largemouth Bass	1	0
Perch	1	1
Sauger	4	3
Shorthead Redhorse	3	3
Shortnose Gar	9	2
White Bass	1	0
	28	64 Totals

G = Gill Net; T = Trammel Net Source: Baldwin and Hey[17/] and Hey and Baldwin[18/]

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

SUMMARY OF MISSOURI RIVER TRAMMEL AND GILL
NET DATA, 1971-1975
(SHEET 3 OF 3)

DATE: SCALE:

TABLE
III-C-7
(Cont'd)

	9-17-71		6-8-73		6-26-73		7-13-73		10-4-73		4-19-74		5-4-74		5-20-74		5-31-74	
	Above	Below	Above	Below	Above	Below	Above	Below	Above	Below	Above	Below	Above	Below	Above	Below	Above	Below
Carp	11	9	29	30	14	9	18	16	8	5	4	18	6	18	3	5	8	12
Carpsucker	15	15	4	2	15	13	9	17	4	4	2	4	5	9	3	3	4	5
Redhorse	1	2	4	5		3	2	1		5				2	<1	2	<1	<1
Smallmouth buffalo		1	2	5	1	2	1	1			1	<1	<1	1		3	2	4
Gizzard shad	4	14	1	2		1		1	15	12	1		1	1				
Freshwater drum	1	4	1		1		2			2		1	<1	<1				<1
Goldeye					1	1	2		1		1	1		4				1
Bigmouth buffalo											1	1	<1		<1	1		
Blue sucker	1			1		1		5								<1	1	<1
Flathead catfish	1	1	1						1		1							
White sucker			1								1							
Channel catfish														<1			<1	
Stonecat														<1				
Mirror carp														<1				
Shortnose gar				1		1		2								1		1
Green sunfish	1	1	1															
White bass		5		2						5				1				
Sauger		1	1			1			2	1								
Walleye			2			1												

Source: Adapted from Baldwin and Hey 13/
and Hey and Baldwin 15/ 18/

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

SYNOPSIS OF ELECTROFISHING RESULTS ABOVE AND BELOW GEORGE NEAL UNITS 1 & 2 (CATCH PER 1000 FT SHOCKED)
(SHEET 1 OF 2)

DATE:
SCALE:

TABLE
III-C-8

	July 25, 1974		November 1974		May 1975		July 1975		October 1975	
	Above	Below	Above	Below	Above	Below	Above	Below	Above	Below
Bigmouth Buffalo		<1				1	<1			
Blue Sucker	<1	1				1		1	<1	1
Carp	14	19	6	7	4	6	4	4	1	3
Carpsucker	10	11	11	13	12	10	17	11	3	5
Channel Catfish		<1				<1				
Flathead Catfish		1					2	<1		<1
Freshwater Drum		<1	<1	<1	<1	1	<1	<1	2	1
Gizzard Shad		<1	5	2		<1			3	40
Goldeye		1			<1	2	3	3		
Largemouth Bass										1
Mirror Carp									2	
River Redhorse					<1	2				
Sauger					<1	<1		<1	<1	1
Shorthead Redhorse	1	<1	1	1			1		1	2
Shortnose Gar					<1	<1				
Smallmouth Buffalo	1	5	2	<1	2	3	<1	1		
Walleye										<1
White Sucker						<1				
White Bass								<1		1

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

SYNOPSIS OF ELECTROFISHING RESULTS ABOVE AND BELOW
GEORGE NEAL UNITS 1 & 2 (CATCH PER 1000 FT SHOCKED)
(SHEET 2 OF 2)

DATE:

SCALE:

TABLE
III-C-8
(Cont'd)

Date	Condenser Passage	Drift Net	Total
May 1974			
Notropis	42	110	152
Sauger	4	0	4
Unidentified	0	1	1
			157
June 1974			
Freshwater Drum	826	62	888
Notropis	108	33	141
Unidentified	6		6
			1,035
July 1974			
Freshwater Drum	132	2	134
Notropis	101	51	152
Unidentified	1		1
			287
August 1974			
Freshwater Drum	4		4
Notropis	3	1	4
			8

Collected with a Wildco Stream Drift Net - Nytex #6 - Aperature 243 u
Weekly interval collections
Condenser passage data represent a composite of 4 thirty minute samples for each date
Drift Net Data for each date represent a composite of 3 five minute drift net samples.

Source: Hey and Baldwin - 17/

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

LARVAL FISH SURVEY, SUMMER 1974

DATE: SCALE:

TABLE
III-C-9

	8,600 gallons river water sampled*		8,600 gallons river water sampled	
Date	Condenser Passage (Net placed in one intake bay of Neal 2	Intake Velocity (f/sec)	Drift Net (Along shoreline, just upstream from intake house at Site 6)	River Velocity (f/sec)
5/15/75	none	0.5	Notropis	2.2
5/22/75	1 egg	0.7	6 Notropis 1 Unidentified	1.4
5/30/75	1 Notropis	0.9	9 Notropis	2.4
6/ 3/75	none	1.0	20 Notropis	1.6
6/ 6/75	none	0.7	25 Notropis	1.7
6/10/75	1 Drum 2 Notropis	0.7	1 egg 2 Bigmouth buffalo 1 Drum 13 Notropis	1.6
6/13/75	4 Notropis	0.5	1 egg 4 Drum 104 Notropis	1.4
6/17/75	8 Notropis	0.6	1 egg 7 Notropis	2.3
6/19/75	6 Drum 13 Notropis	0.4	1 egg 6 Drum 1 Goldeye 23 Notropis	1.4
6/23/75	1 egg 11 Drum 15 Notropis	0.8	48 Drum 36 Notropis 1 Unidentified	1.8
6/26/75	72 Drum 10 Notropis	1.0	96 Drum 19 Notropis	1.5
6/30/75	35 Drum 22 Notropis	0.8	1 egg 47 Drum 25 Notropis	1.8
7/ 3/75	34 Drum 10 Notropis	0.5	19 Drum 50 Notropis	1.6
7/ 6/75	1 Blue Sucker 11 Drum 14 Notropis	0.6	1 Bigmouth buffalo 1 Catostomus 6 Drum 22 Notropis	1.8

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

LARVAL FISH SURVEY, SUMMER 1975

DATE:
SCALE:

TABLE
III-C-10

	8,600 gallons river water sampled*		8,600 gallons river water sampled	
Date	Condenser Passage (Net placed in one intake bay of Neal 3	Intake Velocity (f/sec)	Drift Net (Along shoreline, just upstream from intake house at Site 6	Intake Velocity (f/sec)
7/14/75	12 Drum 10 Notropis		3 Drum 5 Notropis	
7/17/75	1 Ictaluridae 33 Notropis	0.4	1 Centrarchidae 2 Drum 31 Notropis	1.6
7/22/75	5 Notropis		7 Notropis 1 Unidentified	
7/25/75	2 Notropis		1 Drum 7 Notropis	
7/28/75	1 Drum		7 Notropis	
7/31/75	none	0.6	2 Notropis	1.8
8/ 6/75	none	0.5	none	1.6
8/13/75	none	0.5	none	2.8
8/18/75	2 Notropis		2 Notropis	
8/25/75	none		none	

*Amount sampled using two nets

Source: Jane Hey. Briar Cliff College,
Sioux City, Iowa.
Personal Communication

August 1976

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

LARVAL FISH SURVEY, SUMMER 1975

DATE: SCALE:

TABLE
III-C-10
(Cont'd)

than the other sections and the main channel of Section IV was deeper".

g. Trophic Relationships

Relationships among members of the various trophic levels described in Section III-C-2 are summarized in Appendix Exhibit A-III-C-37. Rooted aquatic macrophytes are noticeably absent in the channelized sections, and some of the larger fish species are depicted as ingesting large quantities of allochtonous materials - particularly abattoir, or slaughterhouse wastes. Such species include the carp, carpsucker and channel and flathead catfish.

Many invertebrates and fish are opportunistic, taking organisms, or perhaps wastes, in relation to their availability in the ecosystem. Their food habits reflect relative abundances of food items falling within ingestible size ranges in the waterbody.[31] Those of others indicate selection of one prey species in preference to another. The potential for impact on specific components on the generalized food web shown in Appendix Exhibit A-III-C-37 is discussed in Section IV-B.

h. Rare and Endangered Species

No species of fish indigenous to the Missouri River at Port Neal are included on the U.S. Fish and Wildlife Service list of threatened species. However, the pallid sturgeon (Scaphirhynchus album) has been suggested for inclusion by Dr. Frank Cross of the University of Kansas. The State of Nebraska rates the skipjack herring (Alosa chrysochloris) as rare, and the blue catfish (Ictalurus furcatus) as endangered. A skipjack herring was taken by bag seining in Spring 1972, and a pallid sturgeon was taken by hook and line in 1972.

D. METEOROLOGY AND CLIMATOLOGY

The site of George Neal Steam Electric Station is in the Missouri River Valley at an elevation of about 1075 feet mean sea level (MSL). There are hills about 2 miles southwest of the site with a northwest-southeast orientation. Maximum elevations are about 1500 feet MSL.

The climate of the area is characterized by large fluctuations in precipitation and temperature from season to season and from year to year; this is due to its mid-latitutde and interior continental location. There is a prevailing moist southerly flow from the Gulf of Mexico during the April to November period, causing a summer rainfall maximum with frequent thunderstorms and convective type precipitation. Occasionally hail, high winds and even tornadoes are associated with the thunderstorms. Winters are cold and relatively dry due to the prevailing northwesterly flow of dry Canadian air.

Air masses from the Pacific Ocean moving across the western United States frequently reach the area, producing comparatively mild and dry weather. The autumnal "Indian Summers" are a result of the dominance of these modified Pacific air masses. Unusually hot temperatures and periodic droughts in the area are generally associated with a flow of hot dry winds originating in the southwest desert portions of the country.

The climatology of the site area is mainly based upon meteorological data observed at the National Weather Service Forecast Office at the Sioux City Municipal Airport. The airport is located about 7 miles north of Neal Unit 4 at an elevation of 1095 feet MSL. Meteorological conditions at the airport are considered representative of the site area as there are no significant differences in topography, elevation and physical features. Actual weather conditions at the site, however, can only be determined by on-site measurements.

Meteorological data from Des Moines, Iowa and Omaha, Nebraska have been used whenever specific data from Sioux City were not available. Des Moines is about 155 miles southeast and Omaha about 80 miles south of the site. Although climatic conditions are generally similar, the distances between these stations and the site limit the representativeness of these data to specific weather conditions in the site vicinity.

1. Temperature

Table III-D-1 gives average and extreme dry bulb temperatures and Table III-D-2 gives the specific frequency of monthly and seasonal wet bulb temperatures. These temperatures are based upon data for Sioux City for the base periods specified in the tables. A computer program was utilized to tabulate specific frequencies of wet bulb temperatures from hourly data.

Month	Daily Avg. Maximum (° F)	Daily Avg. Mininum (° F)	Monthly Average (° F)	Extreme Highest (° F)	Year	Extreme Lowest (° F)	Year
January	27.9	9.5	18.7	59.0	1964	-26.0	1970
February	31.7	12.6	22.2	66.0	1972	-26.0	1962
March	42.5	23.7	33.1	91.0	1968	-22.0	1960
April	59.9	37.8	48.9	94.0	1960	19.0	1968
May	72.9	49.8	61.4	102.0	1967	28.0	1967
June	82.5	60.3	71.4	104.0	1961	40.0	1969
July	89.5	65.2	77.4	102.0	1964	42.0	1971
August	86.9	63.2	75.1	101.0	1964	43.0	1967
September	78.2	52.8	65.5	101.0	1971	30.0	1967
October	66.9	41.1	54.0	93.0	1963	13.0	1972
November	46.7	25.5	36.1	77.0	1971	-6.0	1964
December	34.5	15.4	25.0	64.0	1970	-19.0	1968
Annual	60.0	38.1	49.1	104.0	1961	-26.0	1970

Extreme temperature data based on 13 Year base period.

Source: Sioux City local Climatological Data, U S Department of Commerce, 1972.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

AVERAGE AND EXTREME DRY BULB TEMPERATURES
SIOUX CITY, IOWA (1931 - 1960)

DATE:

SCALE:

TABLE
III-D-1

Month/Season	Specific Frequency (Percent) (1) 1	2	10	20	50	75	90
December	50.0° F (2)	40.0° F	35.0° F	31.0° F	22.0° F	11.0° F	1.0° F
January	40.0	35.0	32.0	28.0	16.0	4.0	-6.0
February	44.0	37.0	34.0	31.0	23.0	13.0	5.0
Winter	45.0	37.0	34.0	30.0	20.0	9.0	0.0
March	54.0° F	47.0° F	42.0° F	37.0° F	31.0° F	25.0° F	17.0° F
April	64.0	58.01	54.0	50.0	41.0	35.0	30.0
May	72.0	68.0	66.0	62.0	55.0	49.0	43.0
Spring	63.0	58.0	54.0	50.0	42.0	36.0	30.0
June	77.0° F	74.0° F	72.0° F	69.0° F	64.0° F	59.0° F	54.0° F
July	79.0	76.0	74.0	72.0	67.0	63.0	59.0
August	79.0	76.0	74.0	72.0	67.0	62.0	58.0
Summer	78.0	75.0	73.0	71.0	66.0	61.0	57.0
September	77.0° F	73.0° F	70.0° F	66.0° F	57.0° F	50.0° F	45.0° F
October	68.0	62.0	60.0	56.0	46.0	40.0	34.0
November	56.0	49.0	46.0	42.0	33.0	27.0	18.0
Fall	67.0	61.0	59.0	55.0	45.0	39.0	32.0
Annual	76.0° F	72.0° F	69.0° F	64.0° F	46.0° F	29.0° F	15.0° F

Above data based on 3,985-4,464 hourly observations per month.

(1) Specific frequency is defined as the percent of time that wet bulb temperature equals or exceeds the corresponding wet-bulb temperature given in the table.

(2) Temperatures rounded to nearest whole degree.

Source: Hourly Meteorological Data - Sioux City, Iowa. 1959-1964. U S Department of Commerce, EDS, Asheville, North Carolina.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4
SPECIFIC FREQUENCY OF MONTHLY AND
SEASONAL WET BULB TEMPERATURES(° F)
SIOUX CITY, IOWA (1959 - 1964)
DATE: SCALE:

TABLE
III-D-2

The average monthly dry bulb temperature ranges from 18.7°F in January to 77.4°F in July with an annual average of 49.1°F. The extreme highest and lowest temperatures recorded during a 12-year base period were 104°F in June 1961 and -26°F in January 1970 and February 1962. As is characteristic of continental climates, there is a large diurnal range in temperature.

The wet bulb temperature is, along with the dry bulb temperature, a measure of the humidity of the air. It is usually used as the temperature criterion in evaporative cooling processes. The specific frequency of wet bulb temperature indicates the percent of time that it equals or exceeds a given value. The data given in Table III-D-2, for example, indicate the wet bulb temperature in May is 68°F or higher five percent of the time. In September, however, the five percent level is 73°F. Wet bulb temperatures in the site vicinity are highest in July and lowest in January with fall wet bulb temperatures somewhat higher than those found in spring.

2. Precipitation

Average monthly precipitation amounts range from 0.74 inches in December to 4.33 inches in June with slightly less than 3/4 of the annual (24.77 inches) precipitation occurring during the 6-month April-September period. Precipitation amounts ranging from trace to 9.69 inches have occurred during a single month. Average and monthly extreme precipitation data for the site area are presented in Table III-D-3.

Table III-D-4 presents maximum short period rainfall at Sioux City for time periods ranging from 5 minutes to 24 hours. These maxima all occurred during summer months and are typical of maximum rainfall values at other recording stations in the region (Des Moines, Omaha, Drexel and Sioux Falls).[1] The Sioux City maximum values are far less than the maximum observed rainfalls in other parts of the United States.

3. Drought

Drought occurs periodically in Iowa; the most severe in recent decades was during the 1930's. Other years of drought were 1886, 1894, 1901, 1910, 1916, 1918, 1927 and the mid-1950's.

4. Snowfall

Snowfall occurs primarily during the months from November to March, although snow has been recorded as early as September and as late as May. The average annual snowfall at Sioux City is 31.6 inches. However, the annual snowfall has ranged from 7.9 inches during the 1968-1969 season to almost 66 inches in the 1959-1960 and 1961-1962 seasons. Snowfalls of one or more inches occur on an average of 10 days per year. The maximum snowfall in the area in a 24-hour period was 20 inches in April 1913.

Month	Average Precipitation	Maximum Monthly(1)	Year	Minimum Monthly	Year
January	0.78	2.44	1949	0.11	1948
February	0.89	2.48	1954	0.17	1949
March	1.46	3.19	1962	0.29	1956
April	2.25	4.35	1951	0.45	1942
May	3.23	8.46	1959	0.60	1955
June	4.33	8.67	1957	1.87	1958
July	3.11	6.12	1962	0.41	1947
August	2.66	7.75	1951	0.61	1955
September	2.74	9.69	1965	0.07	1950
October	1.42	3.73	1946	T(2)	1958
November	1.16	4.10	1948	0.04	1949
December	0.74	1.68	1945	0.01	1943
Annual	24.77	9.69	1965	T	1958

(1) Maximum and minimum data based on a 26-Year period of record.

(2) Trace is defined as an amount too small to measure.

Source: Sioux City Local Climatological Data, U S Department of Commerce, 1972.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

AVERAGE AND MONTHLY EXTREME PRECIPITATION
(INCHES) SIOUX CITY, IOWA (1931-1960)

DATE: SCALE:

TABLE
III-D-3

Time Period	Period of Record	Rainfall (Inches)	Date of Occurrence
5 min	1907-1961	0.77	7/21/28
10 min	1907-1961	1.40	7/21/28
15 min	1907-1961	1.75	7/21/28
30 min	1907-1961	2.73	6/13/30
1 hr	1907-1961	2.94	7/21/28
2 hr	1907-1961	3.43	8/21/61
3 hr	1907-1961	3.58	6/ 3/40
6 hr	1907-1961	4.02	6/ 3/40
12 hr	1907-1961	5.11	6/ 3/40
24 hr	1891-1961	5.12	6/ 3/40

Source: Maximum Recorded United States Point Rainfall, U S Weather Bureau, 1963.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

MAXIMUM SHORT PERIOD RAINFALL
SIOUX CITY, IOWA

DATE:
SCALE:

TABLE
III-D-4

Table III-D-5 presents the average and maximum monthly snowfall and the average number of days each month with a snowfall of one inch or more at Sioux City.

5. Severe Weather

Destructive storms in the region include thunderstorms, hail and freezing precipitation (glaze). Table III-D-6 gives the monthly and annual frequency of these phenomena in the area. About 94 percent of the 47 thunderstorms per year occur during the April to September period, with June having the greatest frequency. Damaging hailstorms reach a maximum in early summer, average three per year destroying about 1 or 2 percent of the major crops.[2] Freezing precipitation is the result of supercooled rain or drizzle falling on surfaces with temperatures below 32F.[3] The precipitation is supercooled by passing through subfreezing air just before striking the ground. Severe storms of this nature can considerably reduce highway traffic, stretch or break transmission lines and damage trees. There are, on the average, nine glaze storms per year at Des Moines, with December being the month with the maximum frequency of these storms. During the 1953-1962 period, 15 tornadoes were reported in the Sioux City area.

6. Winds

The prevailing wind directions at Sioux City during the winter months (November through April) are northwest and north-northwest with average wind speeds of about 14 miles per hour (mph). Prevailing winds are from the southeast and south-southeast during the June-September period with average speeds of about 12 mph. Winds are transitional in May and October. Northwest and north-northwest winds have a total annual frequency of about 21 percent and southeast to south-southeast winds have a total annual frequency of about 22 percent. Calm conditions have a monthly frequency that ranges from 1 percent to slightly less than 3 percent. An annual wind rose is shown in Exhibit III-D-1.

The extreme mile wind speed is equal to the one mile passage of wind with the greatest speed during a given period at a height of 30 feet above the ground. Table III-D-7 gives monthly extreme mile wind speeds and Table III-D-8 gives the recurrence interval of extreme mile wind speeds. The maximum mile wind speed during a 32-year period was 91 mph in June 1945. Winds of this magnitude can be expected every 100 years, and winds with 70 mph wind speeds can be expected to occur every 10 years.

The persistence of winds from a given direction is, along with speed and direction, another identifying characteristic of the wind regime at a given locale. Table III-D-9 presents the maximum persistence of wind direction at Sioux City during a 6-year period. A computer program was utilized to determine the maximum number of hours during the period that the wind was from each of 16 wind sectors (each sector is 22.5 degrees) and also

Month	Average Snowfall (Inches)	Average Number of Days of 1 Inch or More	Maximum Snowfall [1] (Inches)	Year
January	6.1	2	19.4	1936
February	6.1	2	25.0	1936
March	8.2	3	26.2	1962
April	1.2	**	8.8	1937
May	0.2	**	4.0	1945
June	0.0	0	0.0	-
July	0.0	0	0.0	-
August	0.0	0	0.0	-
September	T(2)	0	0.4	1961
October	0.4	**	5.1	1970
November	3.0	1	15.1	1959
December	6.4	2	20.6	1968
Annual	31.6	10	26.2	1962

(1) Period of record 1933-1973.

(2) Trace is defined as less than 0.05 inches.

** Less than one-half day.

Source: Sioux City Local Climatological Data, U S Department of Commerce, 1972.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

AVERAGE AND EXTREME SNOWFALL DATA
SIOUX CITY, IOWA (1931 - 1960)

DATE:

SCALE:

TABLE
III-D-5

Month	Frequency (Number of Days per Month per Year)		
	Thunderstorms(1)	Hail(1)	Freezing(2) Precipitation
January	*	0	2
February	*	0	2
March	1	**	1
April	4	1	0
May	8	1	0
June	10	1	0
July	9	**	0
August	8	**	0
September	5	**	0
October	2	**	0
November	*	0	1
December	*	0	3
Annual	47	3	9

(1) Thirty-two year period of record for Sioux City, Iowa
(2) Ten-year period of record for Des Moines, Iowa
* Less than one-half day per month
** Less than one day per month

Sources: Sioux City Local Climatological Data, U S Department of Commerce, 1972.
Climatic Summary of the U S - Sioux City, U S Weather Bureau, 1930.
Glaze - It's Meteorology and Climatology, Geographic Distribution and Economic Effects. Quartermaster Research and Engineering Command, Tech Report EP-105, 1959.

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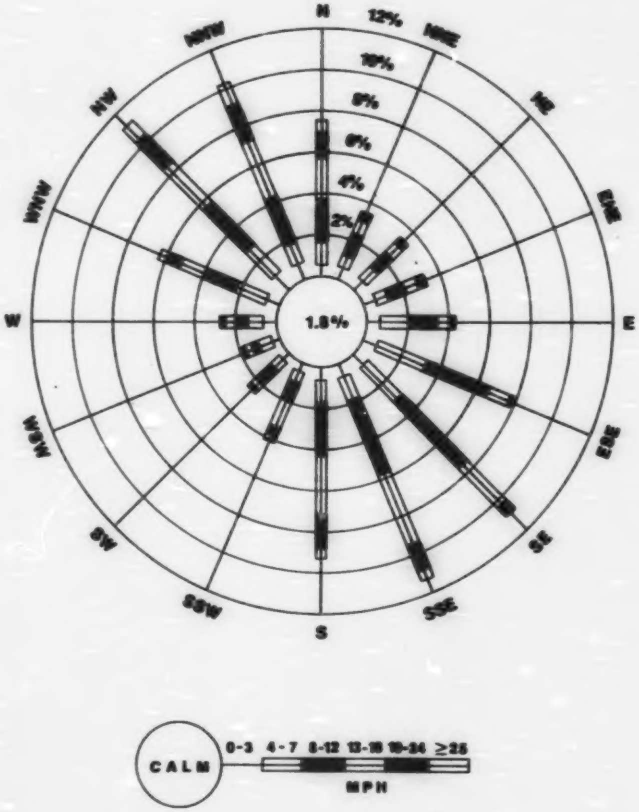
SEVERE WEATHER PRECIPITATION
SIOUX CITY – DES MOINES, IOWA

DATE: SCALE:

TABLE
III-D-6



PERCENTAGE FREQUENCIES
OF WIND DIRECTION AND SPEED

DIRECTION	0 - 3	4 - 7	8 - 12	13 - 18	19 - 24	25 - 31	32 - 38	39 - 46	47 OVER	TOTAL	AV SPEED
N	.5	1.2	2.1	2.0	1.0	.6	.1	*		7.6	12.9
NNE	.6	.7	1.2	.9	.2	*	*			3.6	10.6
NE	.6	.9	1.1	.6	.1	*	*			3.1	9.5
ENE	.6	.8	1.0	.6	.2	*	*			2.9	9.3
E	.5	1.5	1.6	.8	.1	*	*			4.2	8.6
ESE	.6	2.6	3.2	1.3	.2	*	*	*		7.9	9.2
SE	.8	2.3	4.5	2.8	.3	.1	*		*	10.7	10.5
SSE	.6	1.4	3.8	3.7	1.3	.3	.1	*	*	11.0	12.9
S	.5	1.2	2.6	2.9	1.5	.4	.1	*		9.3	13.8
SSW	.3	.6	1.1	1.2	.8	.2	.1	*	*	4.0	12.9
SW	.4	.8	.7	.5	.1	*	*			2.4	9.6
WSW	.3	.6	.3	.3	.1	*	*			1.8	8.9
W	.5	.7	.7	.6	.1	*	*	*		2.6	8.8
WNW	.7	1.5	1.7	1.4	.8	.2	.1	*	*	6.3	11.3
NW	.8	1.9	2.9	2.8	1.6	.9	.2	.1		11.2	13.7
NNW	.5	1.3	2.6	2.8	1.8	.9	.3	.1		10.1	13.0
CALM	1.8									1.8	
TOTAL	9.6	19.9	31.0	26.8	10.1	2.6	.9	.2	*	100	11.7

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

SURFACE WIND ROSE - SIOUX CITY, IOWA
ANNUAL (1951 - 1960)

DATE:

SCALE:

EXHIBIT
III-D-1

Month	Speed (mph)	Direction	Year of Occurrence
January	56	NW	1967
February	54	NW	1947
March	61	N	1950
April	68	W	1946
May	80	W	1956
June	91	W	1945
July	66	NW	1967
August	56	NW	1951
September	66	S	1957
October	70	W	1940
November	59	NW	1954
December	53	NW	1968
Annual	91	W	1945

Extreme mile windspeed is the one mile passage of wind with the greatest speed at a height of 30 feet above the ground. Data base is a 32-year period of record.

Source: Sioux City Local Climatological Data, U S Department of Commerce, 1972.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

MAXIMUM MONTHLY EXTREME MILE WINDSPEED
SIOUX CITY, IOWA

DATE: SCALE:

TABLE
III-D-7

Extreme Mile Windspeed (mph)	Recurrence Interval (Yrs)
70	10
75	25
81	50
90	100

Extreme mile windspeed is the one mile passage of wind with the greatest speed at a height of 30 feet above the ground. Data base is a 21-year period of record.

Source: Thom, H.C.S.[12]

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

RECURRENCE INTERVALS OF EXTREME MILE WINDSPEEDS SIOUX CITY, IOWA

DATE: SCALE:

TABLE III-D-8

One-Sector Wind Direction (1)			Hours	Three-Sector Wind Direction (2)			Hours
Wind Direction	Date	Avg. Speed (mph)		Wind Direction	Date	Avg. Speed (mph)	
N	1-13-60	10.4	13	NNW-N-NNE	1-11-63	16.2	49
NNE	12-20-62	9.7	21	N-NNE-NE	12- 1-60	20.2	67
NE	6-20-59	9.3	9	NNE-NE-ENE	3-26-59	19.6	56
ENE	4- 3-64	20.1	21	NE-ENE-E	2- 3-64	11.0	42
E	5- 2-64	8.5	16	ENE-E-ESE	3-15-60	12.5	43
ESE	3-15-60	12.5	28	E-ESE-SE	5- 6-61	18.0	57
SE	1-30-60	12.3	23	ESE-SE-SSE	3- 3-62	13.0	67
SSE	11-28-62	13.1	35	SE-SSE-S	6-25-63	15.5	71
S	5-25-59	20.1	16	SSE-S-SSW	5-17-62	17.3	64
SSW	4-25-62	20.1	16	S-SSW-SW	2- 3-59	17.3	20
SW	5-12-59	10.3	9	SSW-SW-WSW	4-24-62	13.4	18
WSW	10-31-59	15.0	7	SW-WSW-W	4-14-64	20.3	21
W	4-14-64	20.3	21	WSW-W-WNW	5-24-62	14.7	28
WNW	9- 2-59	11.1	14	W-WNW-NW	9-24-64	12.7	50
NW	1-16-59	15.7	29	WNW-NW-NNW	12-30-59	18.8	97
NNW	10-24-59	25.7	32	NW-NNW-N	2-12-63	16.0	62

The maximum persistence of wind direction is the greatest number of consecutive hours during the 1959-1964 period that the wind direction was from the given direction or directions. Data is based on 52,589 hourly observations during the 1954-1964 period.

(1) Wind was from the one given wind direction for the given number of consecutive hours.

(2) Wind was from any one of the three adjacent wind directions for the given number of consecutive hours.

Source: Hourly Meteorological Data - Sioux City, Iowa, 1959-1964, U S Department of Commerce, EDS, Asheville, North Carolina.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

MAXIMUM PERSISTENCE OF WIND DIRECTION
SIOUX CITY, IOWA (1959 – 1964)

DATE: SCALE:

TABLE
III-D-9

from each of 16 groups of three adjacent wind sectors. The maximum persistence of wind direction from one sector was 35 hours of winds from the south-southeast on November 28-29, 1962. The maximum persistence of wind direction from any one of three adjacent directions was 97 hours of winds from either the west-northwest, northwest and north-northwest during a period starting December 30, 1959. The data indicate that in general, winds from the northwest, southeast and adjacent directions tend to be the most persistent; these also are the prevailing wind directions in the Sioux City area.

7. Visibility and Fog

Table III-D-10 gives the percent frequency of restricted visibility at Des Moines and fog at Sioux City. The restricted visibilities given in this table are mainly due to haze, smoke, fog and precipitation. The percent frequency of dense fog is associated with visibilities reduced to 0.25 miles or less.

The incidence of both restricted visibility and fog is greatest during the fall and winter months and least during the spring and summer months. This is probably due to the higher frequency of inversions during the winter and fall seasons which inhibit the dispersion of water vapor and pollutants (see Section III-D-8).

8. Diffusion Climatology

The dispersion characteristics of the atmosphere depend mainly on horizontal wind speed, thermal stability and surface roughness. The distribution of these parameters defines the diffusion climatology at a particular site.

Pasquill[5] correlated thermal stability with solar radiation and surface wind speed. The resulting Pasquill classification of thermal stability ranges from extremely unstable (Class A) to extremely stable (Class F). Turner[6] proposed a scheme for the classification of thermal stability which utilized hourly surface meteorological data. The Turner stability classes are described and compared to those of Pasquill in Table III-D-11.

Table III-D-12 gives the seasonal percent frequency of stability classes at Sioux City. These frequencies were determined by a computer program for the period 1959-1969. Hourly meteorological observations from Sioux City were stratified into stability classes in accordance with the method developed by Turner. This procedure correlates the vertical temperature lapse rate with solar elevation angle, total cloud cover, cloud ceiling height and wind speed.

Neutral (Class 4) conditions prevail most of the time (58.1 percent) while stable (Class 5-7) and unstable (Class 1-3) conditions are less frequent (27 percent and 15 percent, respectively). Neutral conditions are most prevalent in spring

Season	Restricted Visibility (Miles)[1]					Dense [2] Fog
	0.0-0.5	0.5-1.0	1.0-2.0	2.0-6.0	Total	
Winter	7.9	6.6	8.9	27.1	50.5	10.0
Spring	2.4	3.0	4.9	20.1	30.4	4.3
Summer	0.5	0.6	1.1	12.2	14.4	3.3
Fall	1.5	2.5	3.8	28.1	35.9	5.5
Annual	3.1	3.2	4.7	21.9	32.8	5.2

(1) Des Moines, Iowa. Data base is 12,591 observations.

(2) Sioux City, Iowa. Thirty-two year period of record. Dense fog has visibility reduced to 0.25 mile or less.

Sources: Airway Meteorological Atlas for the United States, U S Weather Bureau, 1941.
Sioux City Local Climatological Data, U S Department of Commerce, 1972.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

PERCENT FREQUENCY OF RESTRICTED VISIBILITIES AND FOG
DES MOINES - SIOUX CITY, IOWA

DATE: SCALE:

TABLE
III-D-10

PASQUILL STABILITY CLASSIFICATIONS	
A.	EXTREMELY UNSTABLE CONDITIONS
B	MODERATELY UNSTABLE CONDITIONS
C.	SLIGHTLY UNSTABLE CONDITIONS
D.	NEUTRAL CONDITIONS – APPLICABLE TO HEAVY OVERCAST DAY OR NIGHT
E.	SLIGHTLY STABLE CONDITIONS
F.	MODERATELY STABLE CONDITIONS

RELATION OF TURNER STABILITY CLASS TO PASQUILL STABILITY CLASS

Turner Stability Class	Pasquill Stability Class
1	A
2	B
3	C
4	D
5	–
6	E
7	F

RELATION OF PASQUILL STABILITY TO WEATHER CONDITIONS

Surface Wind Speed, m/sec.	Strong	Solar Radiation Moderate	Slight	Nighttime Conditions Thin Overcast or 4/8 Cloudiness[a]	 3/8 Cloudiness
Less than 2	A	A–B	B	[b]	[b]
2	A–B	B	C	E	F
4	B	B–C	C	D	E
6	C	C–D	D	D	D
More than 6	C	D	D	D	D

[a] The degree of cloudness is defined as that fraction of the sky above the local apparent horizon which is covered by clouds.

[b] No classifications have been made because the plume is unlikely to have any definable travel.

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

RELATION OF PASQUILL STABILITY TO WEATHER CONDITIONS AND
RELATION OF TURNER STABILITY CLASS TO PASQUILL STABILITY

DATE:
SCALE:

TABLE
III-D-11

Stability Class	Seasonal Frequency (Percent)				
	Winter	Spring	Summer	Fall	Annual
1	0.00	0.21	1.09	0.04	0.34
2	1.13	3.64	8.77	3.43	4.26
3	6.70	8.14	16.40	10.41	10.44
4	64.27	68.67	47.55	52.08	58.06
5	13.39	9.87	12.17	15.70	12.79
6	10.26	6.84	10.24	13.00	10.10
7	4.24	2.64	3.78	5.34	4.01

Data based on 52,589 hourly mean observations.

Source: Hourly Meteorological Data - Sioux City, Iowa, 1959-1964, U S Department of Commerce, EDS, Asheville, North Carolina.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

SEASONAL DISTRIBUTION OF STABILITY CLASSES
SIOUX CITY, IOWA (1959 - 1964)

DATE:

SCALE:

TABLE
III-D-12

as a result of the higher wind speeds during this season and unstable conditions occur most often during the summer due to increased solar radiation. Stable conditions are most frequent in the fall.

Table III-D-13 gives the annual percent frequency of stability classes according to wind direction. The coincident wind speed is also given for each wind direction. These data give an areal representation of the diffusion characteristics of the atmosphere in the site vicinity. In general, the dispersion capacity of the atmosphere increases with increasing instability and higher wind speeds.

Wind direction is not highly correlated with stability but the dispersion capacity of the atmosphere is somewhat greater with winds from the south and west than from other directions (winds from the south-southwest are associated with instability 22 percent of the time). Winds from the northwest through north-northeast have the highest incidence of neutral conditions (68 percent).

The site is in an area which rarely experiences the occurrence of stagnating high-pressure systems.[7] Consequently, there is little potential for persisting high levels of air pollution.

The mixing height is defined as the thickness of the atmosphere layer above the earth's surface through which pollutants are presumed to mix by convection.[8] The higher the mixing height, the greater the dispersion potential of the atmosphere. A study by Holzworth[9] indicates that the potential for episodes with limited dispersion conditions in the site vicinity is less than 5 days per year. An episode of limited dispersion was defined as follows:

- All mixing heights 4920 feet or less.
- Average wind speeds 13 mph or less.
- No significant occurrence of precipitation.
- Above conditions satisfied continuously for at least 2 days.

Mean maximum mixing heights at Omaha, Nebraska[10] range from 1214 feet in January to 4395 feet in July. January mixing heights at other reporting stations in the continental United States range from about 561 feet in Jackson, Wyoming to 4092 feet in Miami, Florida. July mixing heights range from 924 feet in Seattle, Washington to 13,134 feet in Ely, Nevada. The values for Omaha, therefore, are somewhat less than average values in the country but fairly representative of mixing heights for other reporting stations in the upper midwest.

The mixing height is coincident with the height of the inversion base. This height is a boundary delineating the two distinct layers: a well mixed layer below and a stable inversion layer above. Table III-D-14 gives the percent frequency of

Wind Direction	Avg. Wind Speed (mph)	Stability Class							
		1	2	3	4	5	6	7	Total
N	11.1	0.02	0.25	0.42	3.18	0.43	0.39	0.19	4.88
NNE	9.8	0.02	0.21	0.36	2.51	0.39	0.37	0.18	4.05
NE	10.0	0.02	0.21	0.30	1.89	0.24	0.25	0.07	2.98
ENE	10.1	0.01	0.15	0.24	1.93	0.25	0.19	0.08	2.85
E	8.7	0.02	0.21	0.38	2.38	0.60	0.51	0.15	4.24
ESE	8.9	0.02	0.19	0.67	3.97	2.43	1.77	0.17	9.23
SE	10.1	0.01	0.38	1.24	6.25	2.68	1.45	0.24	12.24
SSE	11.5	0.02	0.54	1.47	7.25	1.26	0.73	0.19	11.47
S	12.7	0.02	0.31	1.00	4.38	0.52	0.46	0.17	6.86
SSW	12.2	0.02	0.29	0.84	2.64	0.24	0.28	0.15	4.46
SW	9.1	0.03	0.22	0.40	1.18	0.21	0.35	0.21	2.60
WSW	8.1	0.01	0.13	0.25	0.73	0.23	0.32	0.18	1.85
W	8.5	0.01	0.19	0.41	1.21	0.46	0.61	0.27	3.16
WNW	10.6	0.01	0.22	0.50	2.51	0.57	0.64	0.27	4.71
NW	13.8	0.01	0.33	0.90	8.25	1.32	0.95	0.32	12.07
NNW	13.5	0.02	0.28	0.84	7.54	0.97	0.71	0.29	10.64
Calm	0.0	0.06	0.16	0.21	0.28	0.00	0.12	0.87	1.71
Total		0.34	4.26	10.44	58.06	12.79	10.10	4.01	100.00
Wind Speed (mph)		3.8	5.7	9.3	13.6	8.7	5.6	2.4	

Data based on 52,589 hourly mean observations for period January 1, 1959-December 31, 1964

Source: Hourly Metrorological Data - Sioux City, Iowa, 1959-1964, U S Department of Commerce, EDS, Asheville, North Carolina.

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

PERCENT FREQUENCY OF STABILITY CLASS BY WIND DIRECTION AND COINCIDENT WIND SPEED

DATE:

SCALE:

TABLE
III-D-13

Season	Local Standard Time				
	0500	0800	1700	2000	Average
Winter	72	57	43	61	42
Spring	60	23	8	58	27
Summer	80	15	9	70	33
Fall	64	42	22	71	38
Annual	69	34	20	65	35

Base on inversion less than 500 feet above the station elevation.

Source: Hosler, C.R.,[11/]

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

PERCENT FREQUENCY OF INVERSIONS OMAHA, NEBRASKA (1955 - 1957)

DATE: SCALE:

TABLE
III-D-14

inversions with bases less than 500 feet at Omaha, Nebraska. The seasonal and diurnal variation of inversion frequency is characteristic of a continental climate.[11] Nocturnal stability and daytime instability are prevalent in the lower levels of the atmosphere and there is a higher frequency of inversions during the winter and fall seasons than during the spring or summer. The higher frequency of stability during the colder months is mainly due to a maximum length of a stable nocturnal period with strong radiational cooling from the earth's surface. Average inversion frequencies for Omaha range from 42 percent during the winter to 27 percent during the spring. The annual frequency is 35 percent. The incidence of inversions is greatest during the early morning hours [an annual frequency of 69 percent at 0500 local standard time (LST)] and least during the afternoon with an annual frequency of 20 percent at 1700 LST.

E. BACKGROUND AMBIENT AIR QUALITY

Measurements of background air quality in the vicinity of the Neal Station have been taken by the Iowa Public Service Company intermittently between May of 1972 and March of 1976 as discussed in detail in Appendix A-III-E. For the purposes of this report, ambient data were also obtained from the 1975 reports of the Iowa Air Pollution Control Commission (IAPCC) and the Air Pollution Control Division of the Nebraska Department of Environmental Control (NDEC).

1. Particulate Concentrations

Particulate concentrations were measured by IPS simultaneously with four high volume samplers surrounding the Neal Station.* By comparing the four simultaneous concentrations, (Table III-E-1) it was possible to determine if any level was either incorrect because of a sampling or analysis error, or not representative of the area-wide background because of a localized effect. Such incorrect and non-representative values were not considered in the background analysis. The remaining values, when represented using a log-normal frequency distribution, had a median of 30 ug/m³ and a geometric standard deviation of 1.9. These results correspond to the levels of natural and agricultural dust typical of rural areas, (see USEPA Publication AP-49, Air Quality Criteria for Particulate Matter 1969, p. 15). Although the 75 ug/m³ annual particulate standard is not violated, statistical extrapolation of the data indicates that the 150 ug/m³ 24-hour secondary standard is probably exceeded about twice yearly, while only one such excess is permitted. The 24-hour primary standard of 260 ug/m³ is not expected to be exceeded. It should be noted that this situation is area-wide and is not attributable to the Neal Station, since point-source effects were excluded from the ambient data. The effects of the Neal Station will be described subsequently in Chapter IV.

Particulate matter monitored by the IAPCC in Sioux City exhibited a median of 50 ug/m³ and a geometric standard deviation of 1.8. Although the 75 ug/m³ annual standard is met, the 150 ug/m³ 24-hour secondary standard is projected to be exceeded 11 times yearly. The 260 ug/m³ 24-hour primary standard is projected not to be violated.

The NDEC particulate data for South Sioux City, Table III-E-2, have a median value of 130 ug/m³ and a geometric standard deviation of 1.7. The 75 ug/m³ annual standard is contravened at this location. The 150 ug/m³ 24-hour secondary standard is estimated to be exceeded 144 times yearly, and the 260 ug/m³ 24-hour primary standard 35 times yearly.

The occurrences of high particulate concentrations discussed above are evaluated in detail in Section IV-C-4-c.

---

*The locations of these stations are presented in Appendix Exhibit A-III-E-1 and Table A-III-E-1.

All Total Suspended Particulate (TSP) Data reflects 24-hour sampling periods. Sampling ran from midnight to midnight. All final concentrations are expressed in Micrograms/M^3.

	Micrograms per Cubic Meter			
Day Sampled (midnight-midnight)	North Site	Terra Site	Nebraska Site	South Site
11/17/75	-----	-----	-----	-----
11/24/75	-----	-----	23.31	50.20
12/01/75	-----	57.92*	7.80	-----
12/08/75	31.24	-----	-----	47.90
12/14/75	21.72	25.11	27.24	40.40
12/21/75	-----	33.11	27.10	28.21
12/28/75	-----	59.70	39.00	42.26
1/04/76	-----	-----	28.11	-----
1/11/76	-----	65.21	41.52	65.60
1/18/76	-----	140.08*	91.60	-----
1/25/76	53.69	28.30	25.10	43.20
2/ 1/76	16.13	12.96	14.54	71.08*
2/ 8/76	12.75	11.94	13.68	27.30
2/15/76	67.73	103.31*	55.62	45.04
2/22/76	6.72	17.71	17.98	22.39
2/29/76	60.67	89.19	61.41	62.85
3/07/76	19.02	19.47	25.49	22.68
3/14/76	16.75	21.72	20.24	-----

*Not considered.

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

AIR QUALITY MONITORING SYSTEM
HIGH VOLUME SAMPLER DATA

DATE: SCALE:

TABLE
III-E-1

DATE	CONCENTRATIONS (micrograms per cubic meter)	WIND DIRECTION* (degrees)
1/06/75	Invalid	190
1/18/75	24.8	290
1/30/75	53.3	30
2/11/75	71.3	320
2/23/75	98.5	340
3/07/75	46.9	330
3/19/75	210.0	220
3/31/75	182.2	340
4/12/75	137.0	240
4/24/75	219.5	100
5/06/75	295.8	120
5/18/75	196.1	70
5/30/75	129.8	350
6/11/75	73.2	290
6/23/75	145.8	150
7/05/75	138.9	290
7/17/75	271.0	180
7/29/75	169.8	140
8/10/75	119.1	110
8/22/75	119.7	100
9/03/75	160.6	340
9/15/75	92.0	170
9/27/75	105.4	180
10/09/75	205.5	280
10/21/75	221.6	340
11/02/75	148.4	150
11/14/75	87.4	50
11/26/75	Invalid	
12/08/75	62.9	310
12/20/75	99.1	340

*North is equal to 0° and 360°.

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4
TOTAL SUSPENDED PARTICULATES
CITY - SOUTH SIOUX CITY, COUNTY - DAKOTA
LOCATION - CITY OFFICES
DATE: SCALE:

TABLE
III-E-2

2. Sulfur Dioxide Concentrations

Sulfur dioxide (SO2) monitoring conducted by the IAPCC at an urban location (Sioux City) and by the NDEC at more industrial (South Sioux City, Table III-E-3) and rural (Grand Island, Nebraska) sites, indicate that background SO2 levels in the region are negligibly low. Similarly, background sulfate levels which may result from the oxidation and hydration of SO2 as it is transported over great distances appear also to be low in the area. Based on EPA data, background sulfate levels are expected to average 2 ug/m³.

3. Nitrogen Dioxide Concentrations

Nitrogen dioxide (NO2) concentrations measured (using a wet chemical method) by IPS at the Neal Station exhibited a median value of 7ug/m³ and a geometric standard deviation of 1.9. The NDEC NO2 data for Lincoln have a median value of 30 ug/m³ and geometric standard deviation of 2.0. The 100 ug/m³ annual NO2 standard is satisfied at both locations.

4. Emission Inventory Data

Current emission inventory data obtained from the IAPCC (for Woodbury County) and the NDEC (for Dakota and Thurston Counties) offer some support for the ambient air quality situation discussed above. The major single existing source of particulate matter, is the Neal Station Units 1-3 emitting 1,554 tons per year (tpy). There are also five other major industrial sources within the near vicinity which emit over 2400 tpy for a total emission of over 4000 typ.

There are no point sources in the area which emit sulfur oxides in quantities comparable to the Neal Station emissions. Other than Neal Station Units 1-3, the only major source of nitrogen oxide emission in the area is one nearby industry which emits approximately 1100 tpy. The major source of hydrocarbon emission in the area is Concrete Pipe Machinery in Sioux City (672 tpy).

Table III-E-4 presents a summary of background air quality data.

DATE	CONCENTRATIONS (parts per million)
1/06/75	.000
1/18/75	.000
1/30/75	.000
2/11/75	.000
2/23/75	.000
3/07/75	.000
3/19/75	.000
3/31/75	.000
4/12/75	.004
4/24/75	.000
5/06/75	.000
5/18/75	.000
5/30/75	.000
6/11/75	.000
6/23/75	.000
7/05/75	.000
7/17/75	.000
7/29/75	.000
8/10/75	.000
8/22/75	.000
9/03/75	.000
9/15/75	.000
9/27/75	.000
10/09/75	.000
10/21/75	.000
11/02/75	.000
11/14/75	.000
11/26/75	.000
12/08/75	.000
12/20/75	.000

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

SO_2 BUBBLER CITY - SOUTH SIOUX CITY
COUNTY - DAKOTA, LOCATION - CITY OFFICES

DATE: SCALE:

TABLE
III-E-3

Contaminant	Location	Hours of Data	Median Concentration	Geom. Std. Dev.
Particulates	Neal Sta.(4 sites)	1,272	30 ug/m^3	1.9
"	Sioux City, Ia.	1,296	50 ug/m^3	1.8
"	S.Sioux City, Ne.	672	130 ug/m^3	1.7
Sulfur Dioxide	Sioux City, Ia.	1,320	0 ug/m^3	-
" "	S. Sioux City, Ne.	720	0 ug/m^3	-
" "	Grand Island, Ne.	720	0 ug/m^3	-
Sulfuric Acid	Regional Estimate	-	2 ug/m^3	-
Nitrogen Dioxide	Neal Station	360	7 ug/m^3	1.9
" "	Lincoln, Ne.	1,344	30 ug/m^3	2.0

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

BACKGROUND AIR QUALITY DATA SUMMARY

DATE:

SCALE:

TABLE
III-E-4

F. TERRESTRIAL ECOLOGY

1. Vegetation*

a. Brief History of Natural Vegetation of Woodbury and Dakota Counties

The natural and undisturbed vegetation of Woodbury, Monona, Dakota and Thurston Counties originally consisted of two community types, bluestem or tall grass prairie, and floodplain forests. The former extended from North Dakota and Minnesota south to Oklahoma. It was characterized by the four principle grasses: big bluestem, little bluestem, switchgrass, and Indian grass.[1] Bluestem comprised eighty to ninety percent of the Missouri River lowland vegetation cover, with switchgrass and prairie cordgrass dominant in wetter sites and needlegrass in the dry sandy hillsides[2] (locally scarce in the vicinity of Neal Unit 4). Because of the rich mollisol soils developed under the tall grass, this community type has been entirely replaced by agricultural crops (corn, soybeans); patches of native bluestem prairie may still be found along roadways and railroad tracks.

Floodplain forests formerly extended from the Missouri River's edge to almost a half mile on either side; thin lines of trees and shrubs continued along tributary river and stream banks breaking up the expanses of Nebraska and Iowa tall grass prairie. Soil moisture availability, more than any other factor, determined the distribution of wood plants. Insufficient rainfall limited forested regions to generally riparian and mesic hillside sites.[3] Pure stands of cottonwood and willow, described in more detail below, covered the more frequently flooded first floodplain, while the poorly drained soils of the remaining portions of the valley which were only occasionally flooded, consisted of marshland, cordgrass and bluestem prairies.[2] Forests dominated by basswood (linden) and red oak, presently not found on the Iowa side of the river near the proposed sites, covered the more mesic protected slopes and bluffs.[4]

As with the native prairie, farm crops have replaced much of the original forest vegetation, which now comprises only four and five percent of Woodbury and Dakota Counties, respectively.[5,6] A relatively large portion of the basswood-red oak and bur oak-Kentucky coffeetree-black walnut types remains on the Nebraska uplands of Dakota and Thurston Counties while the cottonwood - willow floodplain forest is limited to scattered patches along the Missouri's banks.

b. Existing Local Natural Vegetation

Exhibit III-F-1 depicts the distribution of plant communities found in the floodplain area of Neal Unit 4. The following descriptions are derived from the study of aerial photographs, visual field inspections,[7] and literature accounts.[2,4]

---

*The latin names of plant species cited in the text are presented on Table III-F-1.

Colloquial Name	Latin Name[a]
Cattail	Typha latifolia
Big bluestem	Andropogon gerardi
Little bluestem	Andropogon scoparius
Switchgrass	Panicum virgatum
Indian grass	Sorghastrum nutans
Prairie cordgrass	Spartina pectinata
Needlegrass	Stipa spartea
Kentucky bluegrass	Poa pratensis
Brome grasses	Bromus spp.
Bunchgrass	Sporobolus airoides
Corn	Zea mays
Wild rye	Elymus sp.
Sedges	Carex spp.
Bullrushes	Scirpus validus
	Scirpus fluviatilis
	Scirpus acutus
Eastern cottonwood	Populus deltoides
Sandbar willow	Salix interior
Peach-leaved willow	Salix amygdaloides
Black willow	Salix nigra
Bitternut hickory	Carya cordiformis
Red oak	Quercus rubra
Bur oak	Quercus macrocarpa
Red elm	Ulmus rubra
American elm	Ulmus americana
Hackberry	Celtis occidentalis
Mulberry	Morus rubra
Knotweed	Polygonum spp.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

LATIN NAMES OF PLANT SPECIES
CITED IN TEXT (SHEET 1 OF 2)

DATE: SCALE:

TABLE
III-F-1

Table III-F1 (Cont'd)

Latin Names of Plants Cited in Text

Colloquial Name	Latin Name[a]
Prairie rose	Rosa blanda
Kentucky Coffee-tree	Trymnocladus dioica
Indigobush	Amorpha fruticosa
Soybean	Clycine max
Smooth sumac	Rhus glabra
Poison ivy	Rhus radicans
Silver maple	Acer saccharinum
Boxelder	Acer negundo
Riverbank grape	Vitis riparia
Virginia creeper	Parthenocissus quinquefolia
Basswood	Tilia americana
Russian olive	Elaeagnus angustifolia
Roughleaf dogwood	Cornus drummondi
Green ash	Fraxinus pennsylvanica
American germander	Teucrium canadense
Wolfberry	Symphoricarpus occidentalis
Coral berry	Symphoricarpus orbiculatus
Elder	Sambucus canadensis
Goldenrods	Solidago spp.
Oxeye	Heliopsis helianthoides
Sunflowers	Helianthus spp.

a/ According to Fernald 18/.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

LATIN NAMES OF PLANT SPECIES
CITED IN TEXT (SHEET 2 OF 2)

DATE: SCALE:

TABLE
III-F-1
(Cont'd)

i. Cottonwood

Homogenous, even aged stands of mature prairie cottonwood and an understory of hackberry, roughleaf dogwood, poison ivy, green ash, and red elm are characteristic. Black and peach-leaved willows are often sparsely distributed. The vines riverbank grape, poison ivy, and virginia creeper are ubiquitous. With suitable soil conditions, basswood and silver maple may in time replace the mature coottonwoods.[7]

Various successional stages of riparian vegetation communities, which are included in Exhibit III-F-1 in the cottonwood type, are developing along the banks of streams and rivers which flow into the Missouri. Following establishment by willows (sandbar and black) and cottonwoods, are shrubs such as coral berry, wolfberry, elder and indigobush. Eventually, cottonwood, elm (red and American), and green ash may comprise a thin strip of closed canopy vegetation.

ii. Open Cottonwood

A sparse distribution of mature cottonwood trees allows development of an extensive shrub layer often consisting of roughleaf dogwood, indigobush, prairie rose, young willows (black, sandbar, and peach-leaved), cottonwoods, and red elms. Commonly associated with these shrubs are the non-woody plants: cordgrass, switchgrass, American germander, and sunflowers.

iii. Mixed Cottonwood

These stands are comprised of mature cottonwood, boxelder, green ash, and peach-leaved willows.

iv. Willow-Elm-Cottonwood

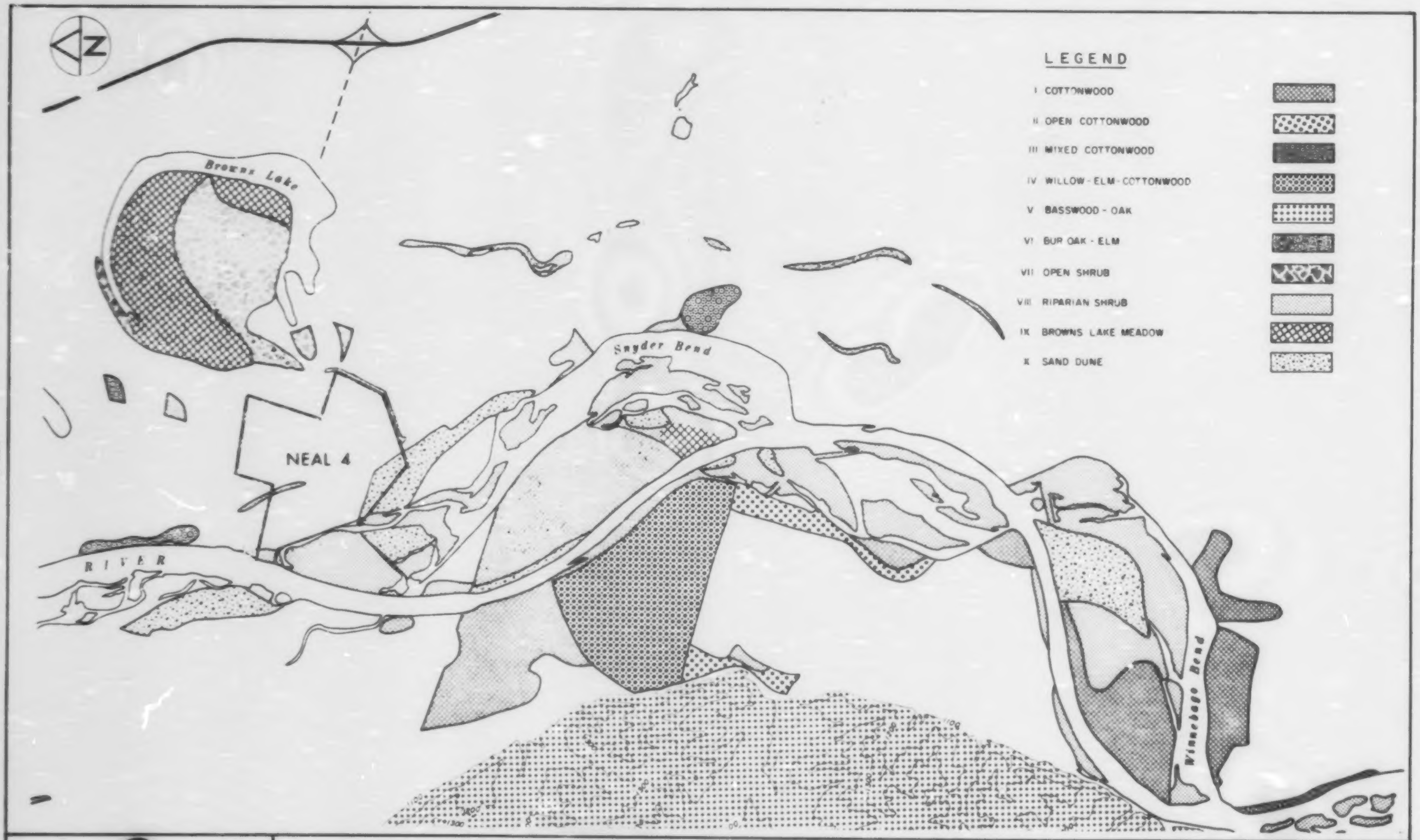
Peach-leaved willow, red elm, and cottonwood constitute canopy species; roughleaf dogwood and poison ivy form a shrub and vine community.

v. Basswood-Oak

Restricted mostly to upland sites, this forest type exhibits a canopy of basswood, red elm, bur and red oak, and hackberry. Red oak predominates mostly along ridges and other xeric sites, while basswood is restricted to more mesic locations.

vi. Bur Oak-Elm

Found on sandy slopes and bluffs, this forest is dominated by bur oak, red elm, and an understory of smooth sumac.


N
Browns Lake
NEAL 4
RIVER
Snyder Bend
Winnebago Bend
LEGEND
I COTTONWOOD
II OPEN COTTONWOOD
III MIXED COTTONWOOD
IV WILLOW - ELM - COTTONWOOD
V BASSWOOD - OAK
VI BUR OAK - ELM
VII OPEN SHRUB
VIII RIPARIAN SHRUB
IX BROWNS LAKE MEADOW
X SAND DUNE

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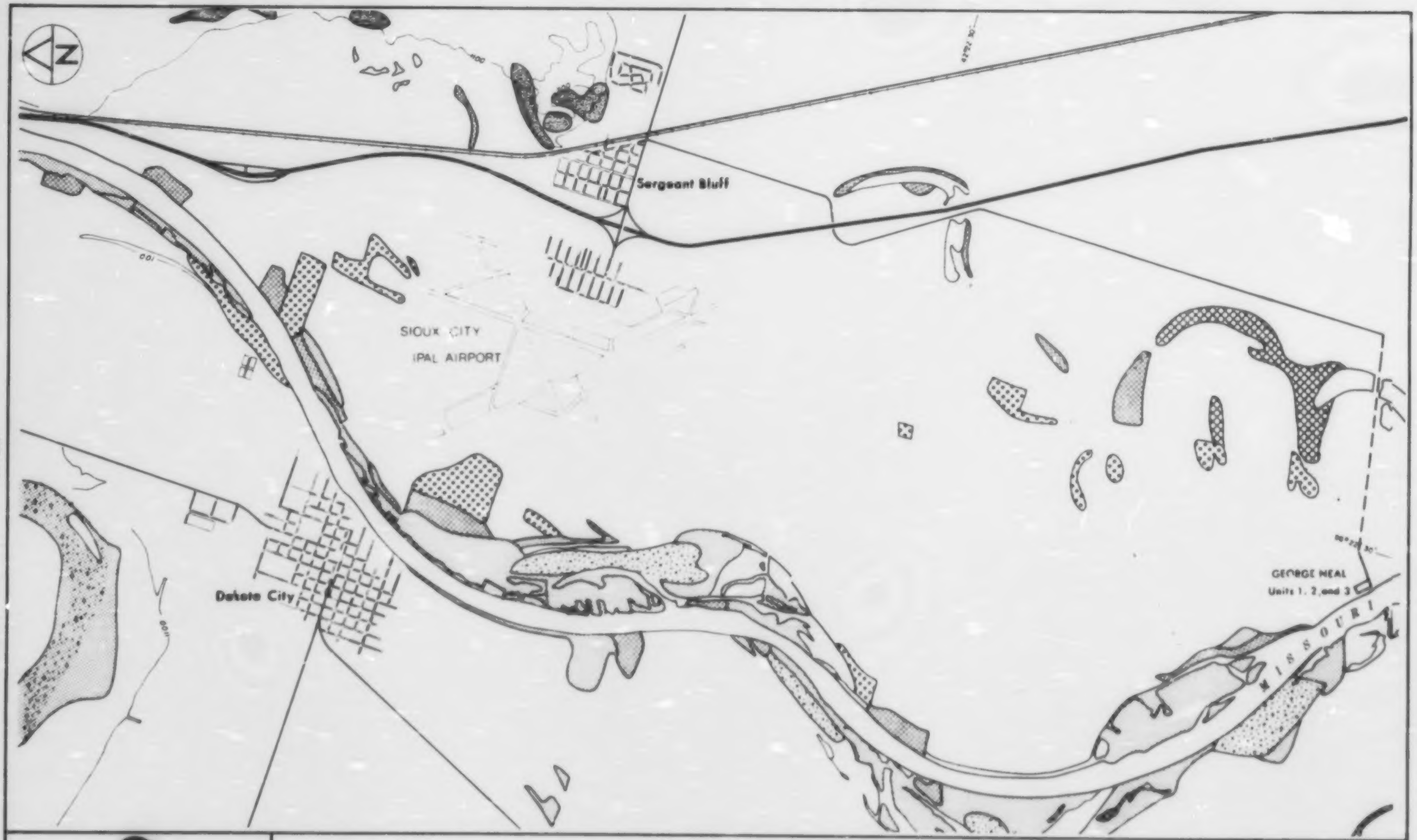
IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

EXISTING NATURAL FLOODPLAIN VEGETATION
SERGEANT BLUFF TO WINNEBAGO BEND

DATE:

SCALE:

EXHIBIT
III-F-1


N
Sergeant Bluff
SIOUX CITY
IPAL AIRPORT
Dakota City
GEORGE NEAL
Units 1, 2, and 3
MISSOURI
100
1100
42°22'30"
96°22'30"

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

EXISTING NATURAL FLOODPLAIN VEGETATION
SERGEANT BLUFF TO WINNEBAGO BEND

DATE:

SCALE:

EXHIBIT
III-F-1
(Cont'd)

vii. Open Shrub

Browns Lake open shrub evidences a few scattered mature cottonwoods, and consists chiefly of shrub and grass communities of roughleaf dogwood, smooth sumac, Kentucky bluegrass, switch grass, and brome grass.

viii. Riparian Shrub

This conglomeration of plant communities is constantly responding to changes in water level and drainage. Some areas, such as the northern portion of Snyder Bend, are comprised almost exclusively of cottonwood saplings and Equisetum spp., with sparsely distributed clumps of bunch grass, willows (sandbar, black and peach-leaved), and roughleaf dogwood.

Sites recently inundated by tne Missouri River exhibit scattered individuals of cottonwood and willow (sandbar).

Areas exposed to standing water for parts of the year are characterized by cattails, knotweed, and barnyard grass.

ix. Browns Lake Meadow

This area has been described as an ecocline of three communities:[7] where standing water is present, cattails predominate; rushes and sedges occupy moist but less inundated sites; and golden rod meadow with switch grass and wild rye as the dominant grasses develops on the most xeric locations. Russian olive and mulberry are common shrubs of the drier meadows.

x. Sand Dune

Relatively unique, this vegetation type is characterized by large open areas of zones having sparsely distributed cottonwood seedlings and shrubs, and colonies of bunch grass.

2. Wildlife

a. Rare, Endangered, or Threatened Species

The Iowa Conservation Commission does not know of any threatened or endangered terrestial fauna, including waterfowl, currently residing in the vicinity of the proposed site[8,9]. Whistling swan, Ross' goose, and golden eagle, which are generally uncommon in northwestern Iowa[17], utilize the backwaters of Snyder and Winnebago bends during migration[10]. Brant, which usually migrate along the eastern flyway[21], have also been reported in this area[10]. Bird species which may be declining significantly in population according to the National Audubon Society's Blue List[11], and which occur along the Missouri River in Iowa, are noted in Table III-F-2.

Species	Status[a]
Double - crested cormorant (Phalacrocorax auritus)	Common migrant
Black - crowned night heron (Nycticorax nycticorax)	Uncommon breeding bird
Sharp - shinned hawk (Accipiter striatus)	Uncommon permanent resident
Cooper's hawk (Accipiter cooperii)	Rare breeding bird
Marsh hawk (Circus cyaneus)	Common migrant. uncommon permanent resident
Osprey (Pandion haliaetus)	Uncommon migrant
Prairie falcon (Falco mexicanus)	Casual
Pigeon hawk (Falco columbarius)	Uncommon migrant
American kestrel (Falco sparverius)	Common breeding bird. uncommon permanent resident
Piping plover (Charadrius melodus)	Rare breeding bird in western Iowa
Least tern (Sterna albifrons)	Uncommon breeding bird
Barn owl (Tyto alba)	Rare permanent resident
Burrowing owl (Speotyto cunicularia)	Rare breeding bird
Loggerhead shrike (Lanius ludovicianus)	Uncommon breeding bird. rare permanent resident
Bell's vireo (Vireo bellii)	Common breeding bird
Grasshopper sparrow (Ammodramus savannarum)	Common breeding bird

a/ As noted in Brown. 17/.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

BIRD SPECIES OF AUDUBON BLUE LIST 11/ FOUND IN THE IOWA-NEBRASKA FLOODPLAIN

DATE: SCALE:

TABLE III-F-2

Approximately 80 to 100 northern bald eagles are estimated to winter in the area of Snyder Bend [12]. The cottonwood forest vegetation type provides shelter for wintering bald eagles, which feed on the winter-killed shad found in the oxbow lakes.

b. Tall-grass Prairie Community

Almost the entire land area originally comprising the tall-grass or big bluestem prairie is presently utilized for agricultural production. Much of the fauna associated with this biome, therefore, is now relatively rare. Table III-F-3 lists those mammals originally indigenous to the Neal site prairie area.

Most of the former prairie is now planted with corn and soybeans. Deer from bottom land forests range several miles into cropland to feed. Cropland is also utilized by raccoon, opossum, badger, quail, pheasants, and eastern cottontail. These croplands are considered marginal for the latter three game species due to harsh winters, predator pressure, and the lack of cover nesting habitat.[12]

c. Riparian Community

The riparian community includes backwaters, marshlands and floodplain forests which border the Missouri River within the region of Neal Unit 4. Table III-F-4 provides density estimates for the most important (recreationally) vertebrates of Snyder Bend and Browns Lake.

The floodplain forests can provide shelter and winter browse for a small population of white-tailed deer.[19] Several deer have been observed at the northern end of Snyder Bend on the site of Unit 4. Locally, high densities of bobwhite quail and ring-necked pheasants occur in the dense cottonwood shrub - Equisetum thickets[19]. This habitat provides undisturbed winter cover and nesting habitat, both of which are limiting factors for quail and pheasants in this region of Iowa[12].

Mammals inhabitating the ecotone along the Missouri River include mink, muskrat, beaver and badger. Other mammalian residents of the Snyder-Winnebago Bends riparian community, as reported[10] are: fox squirrel, eastern cottontail, raccoon, red fox, coyote, opossum, striped skunk, and a variety of small rodents.

Raptors such as the red-tailed hawk, American kestrel, rough-legged hawk, Cooper's hawk, and great horned owl migrate along the Missouri River and utilize the cottonwoods for resting sites. Other birds observed in the cottonwood forest during summer include the mourning dove, common flicker, easter kingbird, blue jay, black-capped chickadee, house wren, American robin, yellow warbler, common yellowthroat, northern oriole, and common

Bison (Bison bison)
Pronghorn antelope (Antilocapra americana)
Wolf (Canis lupus)
Badger (Taxidea taxus)
Blacktail jackrabbit (Lepus californicus)
Whitetail jackrabbit (Lepus townsendi)
Eastern cottontail (Sylvilagus floridanus)
Thirteen-lined ground squirrel (Citellus tridecemlineatus)
Deer mouse (Peromyscus maniculatus)
White-footed mouse (Peromyscus leocopus)
Eastern spotted skunk (Spilogale putorius)
Striped skunk (Mephitis mephitis)
Pocket gopher (Geomys bursarius)
Prairie vole (Microtus ochrogaster)

As reported in Carpenter 14/; Common and Latin names modified according to Burt and Grossenheider 16/

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

MAMMALIAN SPECIES OF THE CENTRAL TALL GRASS PRAIRIE COMMUNITY

TABLE III-F-3

DATE: SCALE:

Species[i]	Density[a]
White-tail deer (Odocoileus virginianus)	1–1.5/100 upland acres[b, c]
Beaver (Castor canadensis)	1 lodge/3 miles of river[d, e]
Muskrat (Ondatra zibethicus)	0.7/wetland acre[f, g]
Ring-necked pheasant (Phasianus colchicus)	0.2–0.3/upland acre[c]
Bob-white quail (Colinus virginianus)	1.0 covey/100 acres[g]
Blue-winged teal[h] (Anas discors)	1.0 nesting pair/5 wetland areas
Wood duck[h] (Aix sponsa)	1.0 nesting pair/10 wetland acres

a/ Values are approximate estimates, provided by District Wildlife Biologist, Neil Heiser 12/.

b/ Upland acres includes all land which is above the cattail zone (without standing water, most of the year).

c/ Winter-season estimate.

d/ Value is approximate estimate provided by Ken Baldwin, 7/ Briar Cliff College, Sioux City, Iowa.

e/ Yearly average.

f/ Wetland acres include all areas located below the cattail zone (covered by standing water most of the year).

g/ Early fall-season estimate.

h/ Summer-season estimate.

i/ Latin names according to Burt and Grossenheider 16/.

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IOWA PUBLIC SERVICE Co. – NEAL UNIT 4

DENSITIES OF IMPORTANT VERTEBRATES OF SNYDER BEND AND BROWNS LAKE PARKS AREA

DATE: SCALE:

TABLE III-F-4

grackle[20]. Red-winged blackbirds and long-billed marsh wrens have been observed in the marshland areas of Snyder Bend[20].

Partially inundated zones of the riparian shrub lands support populations of nesting blue-winged teal, wood duck, and mallards[7]. Aquatic plant productivity, especially the emergent plants bullrush, knotweed, and wild rye, supports flocks of migrating shovelers, gadwalls, lesser scaups, baldpate, buffleheads, pintails, and green and blue-winged teal[13]. Nesting great blue herons and pied-billed grebes, and migrating canvasbacks, and common mergansers, utilized fish, amphibians and crustaceans for food[13].

Snow, blue, white-fronted, and Canada geese migrate along the Missouri Flyway; the first two often winter at Snyder-Winnebago Bends[7]. Snyder Bend provides 250,000 duck-use days for migrating waterfowl during a typical fall season[12]. Large numbers of snow geese and mallards often utilize the floodplain marshes of Snyder bend. One census, performed November 17, 1972 at Snyder Bend, revealed 5500 mallards and 4400 snow geese[12].

Reptiles and amphibians with ranges including the Port Neal area are listed in Table III-F-5. Particularly common reptiles are snapping, painted and softshelled turtles, and the eastern hognose and garter snake (2 species).[10].

d. Existing Stresses on Terrestrial Communities

The encroachment of agricultural operations resulting in artificial drainage of riparian habitat and thus affecting more area of existing natural communities, may represent the greatest presently occurring stress on the biological system near Neal Unit 4. Exhibit III-F-1 depicts the rarity of remaining blocks of cottonwood forest and floodplain forest in general. This paucity of large areas of undisturbed wildlife habitat, particularly forest habitat, increases the sensitivity of terrestrial species to additional environmental stresses which interefere with animal behavior.

Drought, by acting as a differential natural selection agent, may also affect animal and plant abundance.

Species (a)	Latin Name
Common snapping turtle	Chelydra serpentina
False map turtle	Graptemys pseudographica
Ouachita map turtle	Graptemys pseudographica ouachitensis
Western painted turtle	Chrysemys picta belli
Ornate box turtle	Terrapene ornata ornata
Blanding's turtle	Emydoidea blandingi
Smooth softshell turtle	Trionyx muticus
Western spiny softshell turtle	Trionyx spinifer hartwegi
Eastern spiny softshell turtle	Trionyx spinifer spinifer
Northern prairie skink	Eumeces septentrionalis septentrionalis
Five lined skink	Eumeces fasciatus
Six-lined race runner	Cnemidophorus sexlineatus
Northern water snake	Natrix sipedon sipedon
Western plains garter snake	Thamnophis radix haydeni
Red-sided garter snake	Storeria occipitomaculata
Western ribbon snake	Thamnophis sauritus proximus
Northern lined snake	Tropidoclonion lineatum lineatum
Eastern hognose snake	Heterodon platyrhinos
Prairie ringneck snake	Diadophis punctatus arnyi
Eastern yellow-bellied racer	Coluber constrictor flaviventris
Western smooth green snake	Opheodrys vernalis blanchardi
Bullsnake	Pituophis melanoleucus sayi
Western fox snake	Elaphe vulpina vulpina
Red milk snake	Lampropeltis doliata syspila
Prairie rattlesnake	Crotalus viridis viridis
Eastern tiger salamander	Ambystoma tigrinum tigrinum
Plains spadefoot	Scaphiopus bombifrons
Rocky mountain toad	Bufo woodhousei woodhousei
Great plains toad	Bufo cognatus
Eastern gray treefrog	Hyla versicolor versicolor
Blanchard's cricket frog	Acris crepitans blanchardi
Western chorus frog	Pseudacris triseriata triseriata
Boreal chorus frog	Pseudacris triseriata maculta
Northern leopard frog	Rana pipiens pipiens

(a) As recorded in Conant 15/.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

REPTILIAN AND AMPHIBIAN SPECIES WITH RANGES INCLUDING PORT NEAL AREA

TABLE III-F-5

DATE: SCALE:

G. HISTORIC, SCENIC, AND RECREATIONAL SITES

The history of the vicinity of the proposed site and the recreational and scenic development of the surrounding territory is tied to the Missouri River and the associated use of the shorelands. The first complete exploration of the Missouri River occurred between 1804 and 1806 when Meriwether Lewis and William Clark undertook the officially sanctioned Lewis and Clark Expedition. Since that time, the river and abutting lands have undergone intensive periods of use for settlements, commerce, transportation, and agricultural development. More recently the river area has been developed for multipurpose use, such as navigation, irrigation and flood control, the production of goods and services, and scenic and recreation uses.

The following discussions, will present information regarding the historic background of the general site area, the historic and archaeological sites in the general region, the existing parks and recreational areas in the region, and the status of proposals for additional recreational areas.

1. Historical Background of the Site Area

The history of the Missouri River flood plain in the vicinity of the proposed site has been greatly affected by the continuous relocation of the river channel. Through a cycle of erosion and deposition, the Missouri developed oxbow bends which were subsequently cut off, forming shallow lakes and eventually becoming dry land. This process occurred rapidly and was repeated many times in the region surrounding Neal Unit 4.

The cycle has been documented by explorers, river navigators, and scientific parties since the late 1700's. In more recent times man has become the major cause of both realignment and channel stabilization.

The process of river realignment and the corresponding change in adjacent lands has been responsible for the following three major historical consequences in the area of the proposed site: the creation of nearby oxbow lakes; the irregularity of the state boundary between Iowa and Nebraska; and the difficulty in identification of past historical sites.

a. The Creation of Nearby Oxbow Lakes

Several nearby oxbow lakes are present in the area of the site, including Winnebago Lake and Snyder Lake (closest to Neal 4). These lakes and their surrounding areas of sandbar, willow bar, and marsh were created by man-made action in 1962 when the straightening of the Missouri River channel cut off the oxbows from the remainder of the river.

b. Irregularity of the State Boundary

Another recent example of the effect of river action concerns the precise location of the state boundary. The 1943 Iowa-Nebraska Boundary Commission established the official state boundary as the middle of the then stabilized Missouri River channel. Once established, however, the navigation channel has been altered in several places, notably downstream from Neal Unit 4, shifting land once on the Nebraska side of the river to the east side of the present channel.

c. Difficulty in Identification of Past Historical Sites

Because of the continuous process of relocation of the channel of the river, past records, historic sites, and stopping places along the river are difficult to locate. The process has resulted in an uncertainty on the location of some past recorded events, and the river action has probably removed other sites.[1]

The first white traders and explorers used the Missouri for commerce and transportation, but only temporary camp sites and trading posts were placed within reach of the river. The Lewis and Clark Expedition is known to have set up camp in the vicinity of the proposed site, probably west of present day Browns Lake. However, all traces of this temporary camp have been destroyed, most likely as a result of past river action.

Between the 1820's and the Civil War period, the Missouri River was the main means of access for supplies and transportation from the Mississippi River into the frontier West. After the advent of the railroads, additional areas of the countryside were opened up, as was the case with the subsequent widespread use of the automobile.

Agricultural development did not make use of the flood plain land until the late 1920's, when work was begun on channel stabilization. Historic sites along the river have therefore been at a minimum, except at major nodes of river transportation activity and at major river crossing points.

The portion of the Missouri River near the proposed site is part of the river's major navigation system developed after World War II under the Pick-Sloan Plan. This navigational channel stretches from the river's mouth to its terminus in Sioux City.

2. Historic and Archaeological Sites

Coordination with state and local historic offices led to the identification of seven known sites of historical or archeological interest in the two-county area of Neal Unit 4. For Woodbury County, Iowa, the Division of Historic Preservation of the Iowa State Historical Department,[2] and the Sioux City

Public Museum[3] identified three historic sites which are on the National Register[4] while one other is nominated for the Register.

The three National Register sites in Woodbury County are all located in Sioux City. The Sergeant Floyd Monument, which is a national landmark, is a 100-foot obelisk commemorating the Lewis and Clark Expedition. Floyd, who was a co-leader of the expedition, died of an illness in 1806 as the expedition proceeded up the Missouri River.

The Sioux City Central High School on Nebraska Street is commemorated for its Gothic Revival architecture and its contribution to education. In use from 1892 to 1972, it is Sioux City's oldest community high school.

The Woodbury County Courthouse is of historical significance because of its architecture and architectural sculpture. Designed by Steele, Purcell & Elmslie, it is considered the largest public Prairie School style building. This courthouse has been in use since it was built in 1918.

The two National Register sites in Dakota County are Emmanuel Lutheran Church in Dakota City, and Homer village, northeast of Homer.[5] The Emmanuel Lutheran Church in Hickory Street, Dakota City, was built in 1860 and may be Nebraska's oldest Lutheran Church still standing. The Church's Greek Revival frame and structure has been virtually unaltered. Homer Village, or Ton-Wan-Tonga, is an archaeological site last occupied by the Omaha Indians around 1800. The home of Chief Blackbird, the Village was visited in 1796 by James McKay, a fur trader, and in 1804 by Lewis and Clark.

The O'Connor House, south of Dakota City, is a site which has been nominated for the National Register. It is a two-story Italianate house constructed by Captain Cornelius O'Connor, c. 1875.

In addition to these National Register sites, Fort Charles, a fur-trading post set up by James McKay, is known to have been located on a knoll or rise in the vicinity of Homer. The exact site has not yet been determined.

All of the sites described above are a minimum of seven miles away from Neal Unit 4, and there are no reported historic or archaeological sites in the immediate vicinity of Neal Unit 4.

In May 1973, a historical, archeological and cultural survey was conducted and included air and surface examinations of the nearby proposed Snyder - Winnebago Bends Recreation Areas for the U.S. Corps of Engineers.[1] No evidence of historical, archeological or cultural activity was found in the area.

The following is a listing and brief description of additional sites in Dakota County identified by the Historic Preservation Office of the Nebraska State Historic Society[5] and the Dakota County Historical Society[6] as being historically and archeologically significant:

- Bobier Site - c.1400-1450 A.D.

Prehistoric aboriginal earth lodge site assigned to St. Helena Focus. This site is located approximately 4 1/2 miles southeast of Homer.

- Nelson Site - c.1400 A.D.

Earth lodge village located approximately one mile northwest of Homer.

- Ryan Site

Prehistoric and historic woodland burial mound, located just southeast of Homer.

- Site 25DK18

Southeast of Homer, is reportedly a Winnebago trading post.

- Combs Schoolhouse

Erected in 1857, it is the only remaining one-room schoolhouse in Dakota County. It is located near the O'Connor House, south of Dakota City.

The following is a listing of additional sites in Woodbury County identified by the Sioux City Public Museum as worthy of preservation:

- The War Eagle Monument

It is located on a high bluff above the Missouri, near the place where the Sioux River empties into it. War Eagle was a Sioux Indian chief who was friendly to the white settlers. His son-in-law, Theophile Bruguier, is recognized as Sioux City's first white settler, having built a cabin on the banks of the Sioux in 1849.

- Prospect Hill Monument to a Prayer Meeting

Commemorates a prayer meeting held on Prospect Hill (high bluff on Sioux City's west side with a fine view of Iowa, South Dakota and Nebraska) on April 29, 1869, by three Presbyterian ministers. One of them, the Reverend Sheldon Jackson, was so inspired by this experience that he persuaded his church to appoint him Superintendent of Missions to the Western states. The monument was erected in 1913.

- Monument to Cordua and Roberts

This marker is near the spot where two pioneer Sioux Cityans, Henry Cordua and Thomas Roberts, were murdered by the Indians while cultivating their potato field on July 9, 1861. It was dedicated October 13, 1928, by the Woodbury County Pioneer Club and is located on the Correctionville Road, old Highway 20, about three and one half miles east of Sioux City. The crime alerted Sioux Cityans to the ever present danger of the Indians and prompted them to beef up their home guard.

- First Bride's Grave

Grave site of Rosalie Menard Leonais, of French and Indian descent, believed by some to be Sioux City's first bride. It is located on a bluff across from the Floyd Monument on Highway 75 south.

- The Peirce House

Present site of Sioux City Public Museum. It was built by John Peirce in 1891-1892 of South Dakota quartzite at an estimated cost of $80,000. Mr. Peirce has been described as Sioux City's most energetic and ambitious developer, and this house was built to impress eastern investors with Sioux City's potential for growth. Throughout the years the house has been owned by various families, the most prominent having been the T.S. Martin's, one of Sioux City's foremost merchants. In 1960 the house was purchased by the Junior League of Sioux City for $10,000 and donated to the city for a public museum.

According to the Division of Historic Preservation of the State Historical Department of Iowa, there have been no new submissions of sites for nomination to the National Register.

None of the known historical sites in either Woodbury or Dakota Counties are expected to be adversely affected by the proposed project.

3. Existing Parks and Recreation Areas

There are presently several recreational areas and scenic attractions in the general Sioux City-Missouri River vicinity and in the area of the proposed site. These areas offer opportunities for water-oriented activities, camping and picnicking, trail-oriented activities, sightseeing and general recreational activities.

In 1970, Woodbury County had an estimated 2874 total acres of federal, state, county, and municipal parks and recreational areas. In addition, Dakota County, Nebraska had three existing areas, and the surrounding region provided additional recreational opportunities.

In the portion of the Missouri River region where Neal Unit 4 is to be located, the following six recreation resources are considered significant (see Exhibit III-G-1):

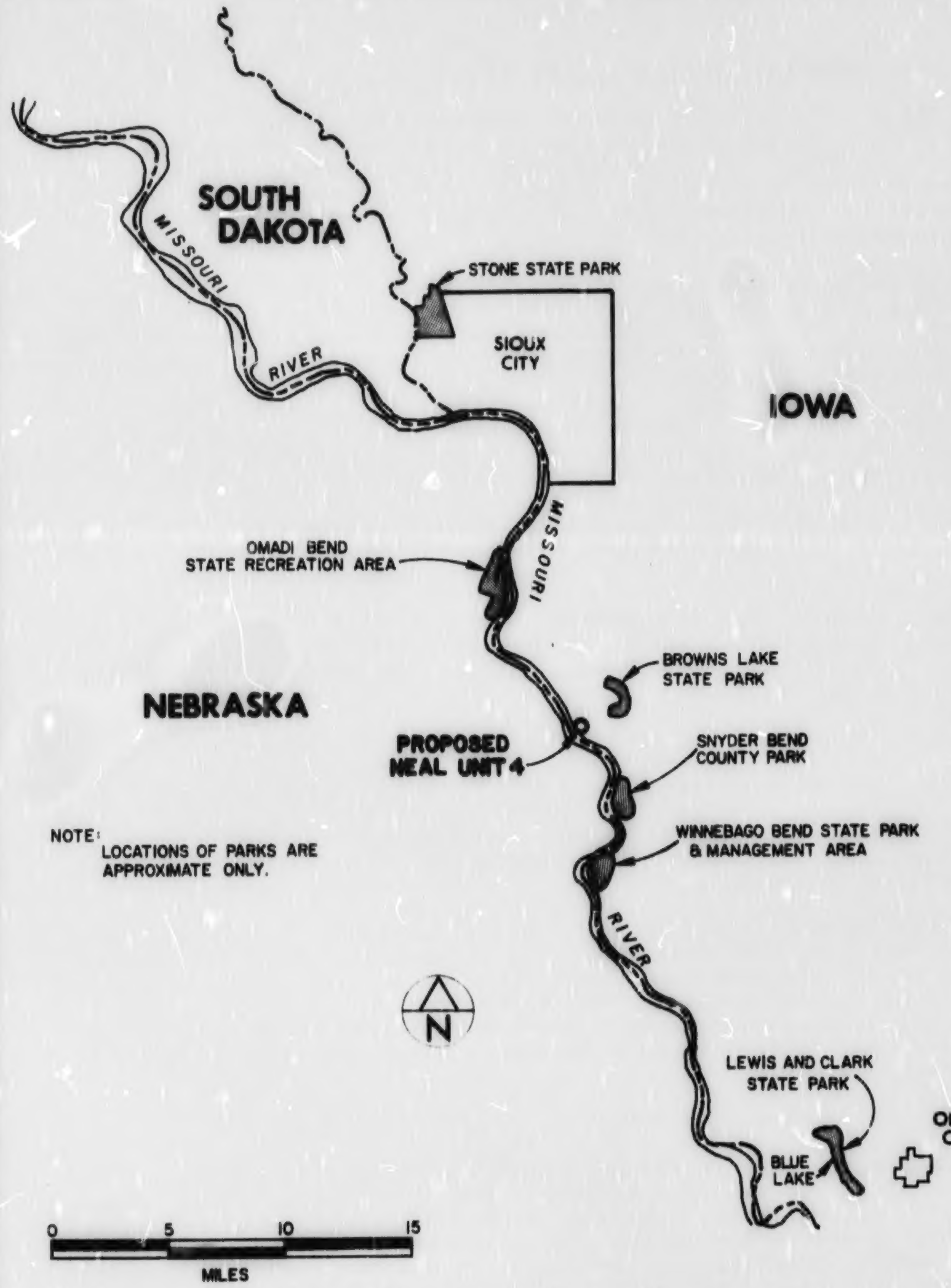
- two parks of regional importance, one north (Stone State Park), the other south (Lewis and Clark State Park), each in excess of 15 miles from the proposed site
- three locally important parks, located east (Browns Lake State Park), southeast (Snyder Bend County Park), and northwest (Omadi Bend State Recreation Area) of the proposed site.
- one state game management area and undeveloped state park (Winnebago State Park), located immediately south of the proposed site.

In addition, both Nebraska and Iowa have wayside areas, stopping points, municipal parks, and other areas of local importance in the general region.

Recreation information for parks of regional importance and parks outside the immediate area of the proposed site has been included for completeness. More detailed information on existing facilities is available in the recreation and open space plans of the Iowa Conservation Commission, the Nebraska Game and Parks Commission, and the comprehensive plans of the individual counties.

a. Stone State Park

This state park in the northern Sioux City area is visited by an estimated 275 thousand visitors from the region each year. Located approximately 17 miles upstream from the proposed site, the park provides facilities for campsites, lodging, trailers, picnicking, fishing, as well as horseback riding and hiking trails. The park's 918 acres overlook the Big Sioux River above the point where it joins the Missouri.


SOUTH DAKOTA
MISSOURI
RIVER
STONE STATE PARK
SIOUX CITY
IOWA
MISSOURI
OMADI BEND STATE RECREATION AREA
BROWNS LAKE STATE PARK
NEBRASKA
PROPOSED NEAL UNIT 4
SNYDER BEND COUNTY PARK
WINNEBAGO BEND STATE PARK & MANAGEMENT AREA
RIVER
N
LEWIS AND CLARK STATE PARK
ONAWA CITY
BLUE LAKE
0
5
10
15
MILES

NOTE: LOCATIONS OF PARKS ARE APPROXIMATE ONLY.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

REGIONAL RECREATIONAL AREAS

EXHIBIT
III-G-1

DATE:
SCALE:

b. Lewis and Clark State Park

The park, located 20 miles south of Neal Unit 4 in Monona County, is the eighth-most used state park in Iowa. The Iowa Conservation Commission estimated that 1973 attendance was more than 315,000. In terms of the combination of regional importance and proximity to the site, the park can be regarded as a southern counterpart to Stone State Park. Facilities include provisions for boating, fishing, campsites, shelter, lodging, picnicking, and trailers.

c. Omadi Bend State Recreation Area

This park is operated by the Nebraska Game, Fish and Parks Commission and is situated on 33 acres of land adjacent to an oxbow remnant of the Missouri River, approximately 5 miles northwest of the proposed site. The park is accessible from Homer, Nebraska, and the area to the west and south. The present facilities include cookout grills, picnic tables, and a boat ramp.

d. Browns Lake (Bigelow Park)

Situated on the southeast shore of Brown's Lake, due west of Salix, Iowa, the park is state owned and is operated and managed by Woodbury County. The park is located about two miles east of the proposed site on a shallow oxbow lake. Facilities include provisions for boating, fishing, picnicking, swimming, and general recreational activities.

Browns Lake (Bigelow Park) has received funding assistance from the Land and Water Conservation Fund. This funding has been used to develop the park's recreational facilities. Therefore the park's land is subject to the provisions of Section 6(f) of the Land and Water Conservation Fund Act, as amended, which requires that changing land from recreational use must be approved by the Secretary of the Interior.

e. Snyder Bend County Park

Snyder Bend Park, operated by the Woodbury County Conservation Commission, provides an area of 34 acres of parkland and access roads, located about one mile southeast of the proposed site. Existing facilities include provisions for boating, fishing, picnicking, camping, field sports, and swimming. The park is situated on the shores of Snyder Lake, which was created in 1962 through relocation of the Missouri River channel. Boats are not allowed on the lake after September 15 of each year, at which time a portion of the lake is managed as a waterfowl refuge.

f. Winnebago Bend State Park and Management Area

Located on the oxbow lake south of Snyder Lake, the Winnebago Bend park area is approximately 5 miles south of the proposed site. The park area itself is undeveloped. The oxbow lake is managed by the Iowa Conservation Commission as a game management area. Existing use of the overall area is light, primarily focusing on fishing, hunting, and sightseeing.

4. Status of Proposals for Snyder-Winnebago Bends Recreation Areas

Since the creation of the Snyder and Winnebago Bend oxbow lakes in 1962, there has been a series of proposals concerning additional park and recreation facilities in this general region of the Missouri, as well as concerning the enlargement, consolidation, and reorganization of existing facilities. The development of the proposed Snyder-Winnebago Bends recreation areas has been variously modified, suspended, and revised as a result of the changing situation concerning: the boundary dispute between Iowa and Nebraska, the ownership claims and participatory rights of the Winnebago Indian Tribe, and the arrangements concerning the precise properties, facilities, and development schedule to be utilized.

Under present development plans, the proposed recreation area will be created by the combination of Snyder Bend lake and Winnebago Bend lake, and the consolidation of the existing recreation facilities around them.

Major new improvements to be undertaken include: a connecting channel between the two oxbow lakes; the construction of levees between the Missouri River and the two cutoff channels; and the construction of water control structures for the lakes: Recreational development is planned to include facilities for camping, hiking, picnicking, swimming, fishing and horseback riding in addition to the provision of access roads, parking areas and sewage disposal facilities. It is planned that motorboating and related water sports activities will take place in the Winnebago oxbow lake, while less intensive recreational use along with fish and wildlife resource improvement will be goals for Snyder Lake.

Regulations concerning farming or private development activities on lands adjacent to the park have not been developed.

Original proposals for the park occurred in 1963 and 1964 when the initial project design was prepared under the authority of the Corps of Engineers. The designs were temporarily postponed, but were revised several years later. In January 1968, the State of Iowa agreed to act as the local sponsor. The Nebraska Game and Parks Commission officially agreed in February 1969 to participate in the project and to assume its proportionate share of costs for development, operation, and maintenance of the project.

At this stage, the plans for the proposed recreation area are progressing. Land acquisition began in March 1970, and construction plans and specifications were completed and sent out for bid in May 1970. Plans for the proposed park were again suspended, however, in June 1970, because of objections by the Winnebago Indians concerning the right of government to acquire Indian lands without the consent of the Tribe.

The plans for the proposed park were again proceeding by January 1973, and a tentative agreement was reached with the Winnebago Indians in May 1973. Since that time, the scheduled development of the proposed park has undergone additional revisions and alterations, and the area enclosed in the proposed park has been slightly modified.

The recreational park project is proposed to be a joint undertaking between the U.S. Army Corps of Engineers, Omaha District, and the State of Iowa, State Conservation Commission. The Federal responsibility would include initial land acquisition and the construction of a protective levee, water control structures, and initial facilities. The State of Iowa, as the local sponsor, would be responsible for the provision of access roads and for operating and maintaining the recreation facilities for the life of the project. Project development costs were proposed to be divided 50 percent each, with the State share primarily comprising State land contributions, including the existing recreation facilities in the area, described above.

H. LAND AND TRANSPORTATION

1. General Existing Land Use

The existing land use of the area surrounding the proposed site, shown in Exhibit III-H-1, was investigated in the following four regions - listed in terms of decreasing area and increasing detail:

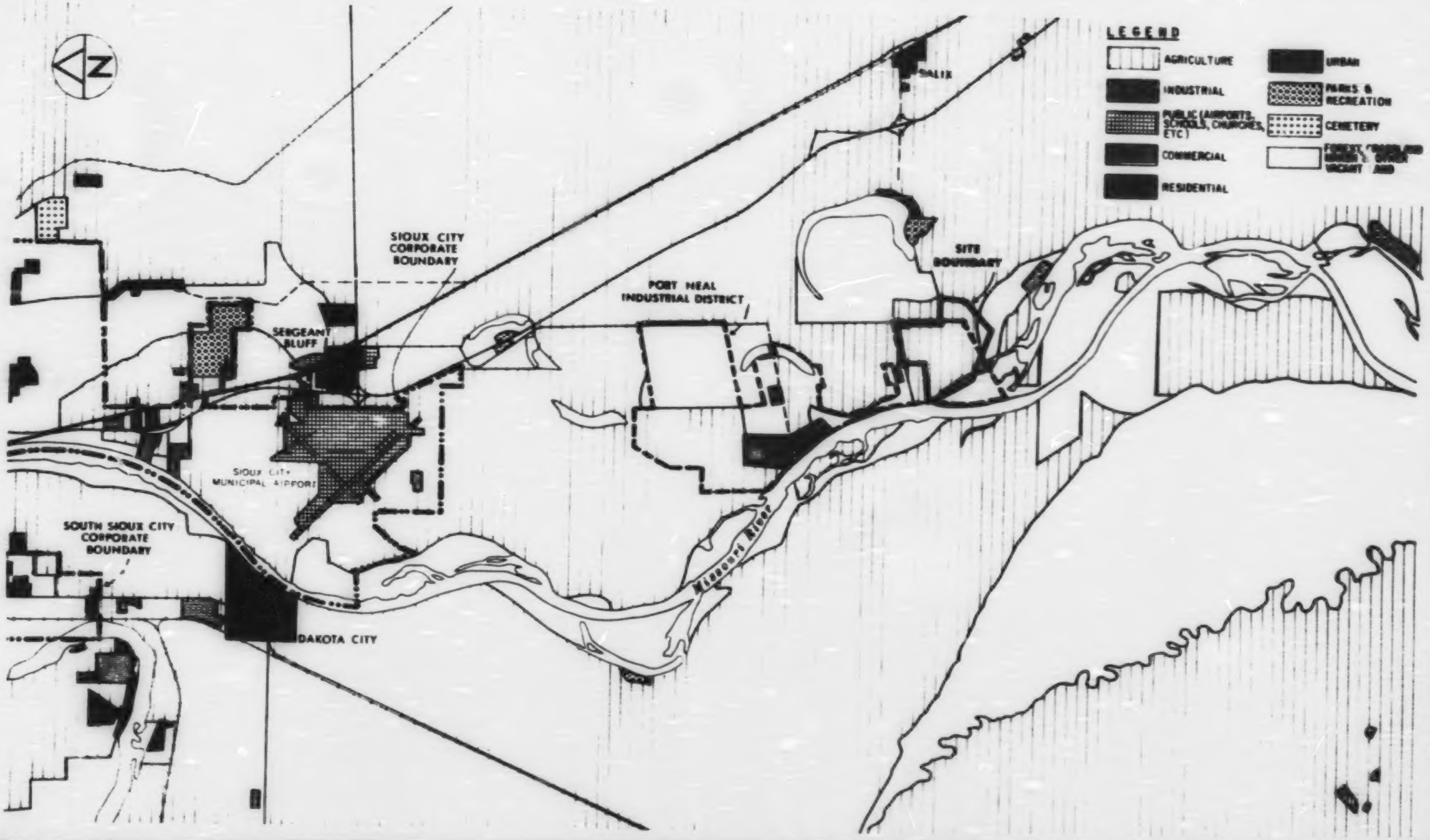
- The four county region, defined as Woodbury and Monona Counties, Iowa, and Dakota and Thurston Counties, Nebraska - 2213 square miles.
- The Sioux City Standard Metropolitan Statistical Area (SMSA) - 1126 square miles.
- Woodbury County, Iowa - 871 square miles.
- The site study area - 160 square miles.

Existing land use within the four county area - Woodbury and Monona Counties in Iowa, and Dakota and Thurston Counties in Nebraska - is primarily devoted to agriculture. Agricultural production accounts for approximately 90 percent of the total land area of the counties. Within the site study area, approximately 76 percent of the total land area is devoted to agricultural use with another 20 percent belonging to forest, grassland, marsh, and vacant lands. The remaining 4 percent of available land is accounted for by other represented land uses of the area including: industrial, public, commercial, residential, and urban. Existing land use within the site study area, expressed in acres and percent of total study area, is given in Table III-H-1.

2. Agriculture

Within the four county regional area 90.5 percent of the total land area is devoted to agricultural production, including all types of croplands, orchards, and grazing lands as indicated in Table III-H-2. Some of the more important crops produced within this area include: field corn, soybeans, hay, sorghum, and other grains and vegetables. Major livestock produced include cattle and calves, hogs and pigs, and, to a lesser extent, poultry, sheep and lambs. Intensive agriculture takes place in the Missouri River valley and on the surrounding hills of the four county region, with grazing lands found on the steeper and less suitable lands.

A breakdown of the agricultural statistics within Woodbury County revealed that, as of the 1969 Census of Agriculture, 92.7 percent of the total land area was designated for farm or farm-related uses. Total cropland for all purposes accounted for approximately 84.5 percent of this amount, while harvested cropland totaled 55.1 percent, and cropland used only for pasture


LEGEND
▥ AGRICULTURE
■ INDUSTRIAL
▦ PUBLIC (AIRPORTS, SCHOOLS, CHURCHES, ETC)
■ COMMERCIAL
■ RESIDENTIAL
■ URBAN
▩ PARKS & RECREATION
▨ CEMETERY
☐ FOREST, GRASSLAND MARSH & OTHER VACANT LAND
N
SALIX
SIOUX CITY CORPORATE BOUNDARY
SERGEANT BLUFF
PORT NEAL INDUSTRIAL DISTRICT
SITE BOUNDARY
SIOUX CITY MUNICIPAL AIRPORT
SOUTH SIOUX CITY CORPORATE BOUNDARY
DAKOTA CITY
Missouri River

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

EXISTING LAND USE MAP

DATE:

SCALE:

EXHIBIT

III-H-1

Land Use Category	Acres	Percent of Total
Agriculture	78,292	76.31
Industrial	496	0.48
Public (Airports, Schools, Churches, Etc.)	895	0.87
Commercial	114	0.11
Residential	349	0.34
Urban	860	0.84
Cemetery	96	0.09
Parks and Recreation	424	0.42
Forest, Grassland, Marsh and Vacant	21,075	20.54
Total Land Area	102,601	100.00

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

EXISTING LAND USE WITHIN THE
NEAL SITE AREA

DATE: SCALE:

TABLE
III-H-1

Four County Region			
	Total Land Area (Sq Miles)	Land in Farms (Inc. Woodland & Grazing Land)	Percent of Total
Woodbury County, Iowa	870.7	806.8	92.7
Monona County, Iowa	699.2	636.7	91.1
Dakota County, Nebraska	255.4	223.9	87.7
Thurston County, Nebraska	387.5	336.2	86.8
Total Four County Region	2,212.8	2,003.6	90.5

Detailed Classification, Woodbury County		
	Acres	Percent of Total
Unincorporated Area:		
Agriculture	502,517	88.7
Transportation, Commercial & Utilities	13,873	2.4
Industrial	753	0.1
Commercial	34	--
Residential	145	--
Public & Semi-Public	961	0.2
Undeveloped Open Space	9,888	1.7
Subtotal	528,171	93.1
Incorporated Cities & Towns	39,711	6.9
Total Woodbury County	567,882	100.0

Source: U S Bureau of the Census, 1969 Census of Agriculture (Top);
General Development Plan, Woodbury County, Iowa, 1970 (Bottom).

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

EXISTING LAND USE IN THE FOUR
COUNTY REGION, AND
WOODBURY COUNTY, IOWA

DATE: SCALE:

TABLE
III-H-2

or grazing accounted for 12.3 percent. The major agricultural crops produced are representative of those in production within the four county region, with vegetables and fruits being of minor importance. Livestock production in Woodbury County, on the other hand, accounts for more poultry farms than the other three counties of Monona in Iowa and Dakota and Thurston in Nebraska. Additional information on agricultural production can be found in Appendix Tables A-III-H -1 and A-III-H-2.

Existing agricultural land use within the immediate site vicinity includes intensive production within the Missouri River valley and surrounding hillsides, with some forests and grazing lands occupying the steeper, less usable slopes. However, livestock grazing and poultry production are minimal within the site study area.

3. Industrial

Industrial land use within the four county study area includes manufacturing enterprises, mainly electronic components, tools, beef products, and chemical and food processing plants. Most of these industrial establishments are located in or within the vicinity of Sioux City, especially along the Missouri River where the land is relatively flat and water is readily available for industrial purposes.

The Port Neal Industrial District comprises almost 3000 acres of relatively flat land along the bank of the Missouri River in Woodbury County. Some of the industries represented in this district include Iowa Public Service Company, Borden Chemical Company, Iowa Beef Processors, Terra Chemicals International, Inc., Kind & Knox Gelatin, Inc., and Farmland Industries. The existing George Neal Steam Electric Station is located within the heart of this Industrial District. The Neal Unit 4 site is located approximately one and three quarter miles south of the existing units.

4. Commercial

Commercial development within the four county area is primarily limited to the vicinity of Sioux City and the South Sioux City area, and along the major roads and highways leading in and out of these urban centers. Most commercial activity outside of the cities and towns is confined to highway oriented services, such as service stations, motels, drive-in restaurants and theaters, etc. In Woodbury County, commercial development is located primarily along Highway 20 between Sioux City and Moville. Smaller commercial centers are found in most of the unincorporated towns. Additional information on industrial and commercial establishments is presented in Appendix Tables A-III-H-3 and A-III-H-4.

5. Public and Semipublic

Public and semipublic uses include such forms as airports, schools, churches, parks, government buildings, etc. Within the four county area most of these uses are found within the vicinity of Sioux City and South Sioux City. The principal public land use within the site vicinity is the Sioux City Municipal Airport - approximately 6 miles south of Sioux City and about 7 miles north of the plant site along the Missouri River. Other public and semipublic uses are located near some of the outlying residential areas in the vicinity of the towns of Salix, Dakota City, and Crystal Lake. Additional information on parks and recreational areas was presented in Section III-G.

6. Residential

Residential areas outside of urban clusters are concentrated in the four county region along the fringes of the metropolitan areas, and within the smaller unincorporated towns. In the immediate site area there are some 349 acres of residential area or less than one percent of the total study area. Residential clusters are located to the east of Sergeant Bluff, south of Sioux City, scattered around the perimeter of Crystal Lake, and clustered along the southeast shore of Browns Lake, about one mile to the east of the proposed site.

7. Urban

Urban lands within the vicinity of the proposed site comprise 0.8 percent of the total land area, or about 860 acres of land. Urban areas include portions of Sioux City and South Sioux City, all of Dakota City, Sergeant Bluff, and Salix. The urban areas are located within the Missouri River valley except for Sioux City which is partially built upon the Missouri River bluffs along the east bank of the river.

8. Transportation

Major transportation routes within the surrounding region include the north-south Interstate Highway, I-29, which extends along the Missouri River valley. The route passes through Omaha, Nebraska and Sioux City, Iowa, as well as other Missouri River communities. At its closest point, Interstate 29 passes within 2-1/2 miles east of Neal Unit 4.

The major east-west highway route is Highway 20 which passes through Sioux City, and continues east to Fort Dodge and Waterloo, and west across the Missouri River into Nebraska. Within the immediate site area, a system of paved roads extends south from the town of Sergeant Bluff, and existing roads are present to the north and east of the proposed site boundaries.

Rail transportation within the four county study area includes the Chicago, Milwaukee, St. Paul and Pacific; the

Chicago and Northwestern; the Burlington Northern; and the Illinois Central Railroads - all serving the Sioux City area. The Chicago and Northwestern tracks parallel Interstate 29 to the east of the site, and a spur which serves the existing Neal units and the Port Neal Industrial district is readily available to be extended and utilized for Neal Unit 4.

I. DEMOGRAPHY

The discussion of demography includes an analysis of past population trends, the composition, distribution, and various other demographic characteristics of the current population, and projections of future population. Areas of focus include Woodbury County, the region within 10 miles of the proposed site, the four counties surrounding the proposed site, and the region within a 100 mile radius of the proposed site.

1. Population History

Woodbury County experienced continuous and significant population growth earlier in this century. This is presented in Table III-I-1 which lists the decennial population counts from 1900 to 1970 for Woodbury County, the Sioux City urbanized area, and the rural portion of Woodbury County. From 1900 to 1930, the County's population increased from 56,610 to 101,669. The statistics indicate that this 46.3 percent increase was due to the growth of the Sioux City urbanized area as opposed to population changes in the rural part of the county. In fact, during that period, the population of the urbanized area increased by 139 percent while the rural area grew by less than 5 percent. Since the 1930 Census, however, the county's population grew slowly to a peak reflected in the 1960 Census and then declined by the 1970 federal count to a point below that recorded in 1940. An examination of Table III-I-1 reveals that the pattern of the past 40 years was caused by a significant loss of rural population to the Sioux City urbanized area.

In 1900, the rural area of Woodbury County comprised 39.4 percent of the total county population. By 1930, this percentage was reduced to 17.3 percent. The 1970 statistics revealed a further decline to 16.9 percent. Table III-I-2 illustrates the changes that have occurred in the urban and rural populations from 1930 to 1970.

Table III-I-3 presents decennial population counts and forecasts from 1920 through 1990 for Woodbury County and the three counties that are within 10 miles of the proposed site. Woodbury County is significantly more populous than Monona, Dakota, or Thurston Counties. Among these counties only Dakota County registered a substantial population increase during the past half century (71 percent).

2. Current Demographic Characteristics

There are eight named places within 10 miles of the proposed site. Exhibit III-I-1 shows a map of this area and a table listing the 1970 populations and positions of each of these places relative to the proposed site. These places ranged in 1970 population from approximately 50 (Luton) to 1153 (Sergeant Bluff). Salix had a 1970 population of 387. Exhibit III-I-2 shows the positions of centers of over 10,000 population which

Year	Woodbury County		
	Rural	Sioux City Urbanized Area	Total
1900	21,499	33,111	54,610
1910	19,788	47,828	67,616
1920	20,944	71,227	92,171
1930	22,486	79,183	101,669
1940	21,263	82,364	103,627
1950	19,926	83,991	103,917
1960	18,690	89,159	107,849
1970	15,973	87,079	103,052

Source: Past population counts provided by U S Bureau of the Census 1973 data are provisional estimates for July 1. provided by the U S Bureau of the Census.

Projected populations from the Iowa State Office of Planning and Programming (Des Moines, Iowa), 1973, and the University of Nebraska, Bureau of Business Research (Lincoln, Nebraska), 1973.

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IOWA PUBLIC SERVICE CO. - NEAL UNIT 4

WOODBURY COUNTY POPULATION TREND

DATE: SCALE:

TABLE III-I-1

	Woodbury County		
Year	Sioux City Urbanized Area	Rural	Total
1930	79.183	22,486	101,669
1940	82,364	21,260	103,627
% Change	+4.0	-5.5	+1.9
1950	83,991	19,926	103,917
% Change	+2.0	-6.2	+0.3
1960	89,159	18,690	107,849
% Change	+6.2	-6.2	+3.8
1970	87,079	15,973	103,052
% Change	-2.3	-14.5	-4.4

Source: U S Bureau of the Census
General Population Characteristics
PC(1)-B17 Iowa

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IOWA PUBLIC SERVICE CO. - NEAL UNIT 4

URBAN AND RURAL POPULATION CHANGES
IN WOODBURY COUNTY, 1930–1970

DATE: SCALE:

TABLE
III-1-2

Year	Woodbury Co.	Dakota Co. (Neb)	Thurston Co. (Neb)	Monona Co.
1920	92,171	7,694	9,589	17,125
1930	101,669	9,505	10,462	18,213
1940	103,627	9,836	10,243	18,238
1950	103,917	10,401	8,590	16,303
1960	107,849	12,168	7,237	13,916
1970	103,052	13,137	6,935	12,069
1974	103,800	14,800	7,300	11,900
1975	108,800	14,401	6,681	12,700
1980	114,400	15,391	6,559	13,200
1985	120,700	16,236	6,603	13,900
1990	126,400	16,925	6,733	14,500

Source: Past population counts provided by U S Bureau of the Census. 1974 data are provisional estimates for July 1, provided by the U S Bureau of the Census.

Projected populations from the Iowa State Office of Planning and Programming (Des Moines, Iowa), 1975, and the University of Nebraska, Bureau of Business Research (Lincoln, Nebraska), 1973.

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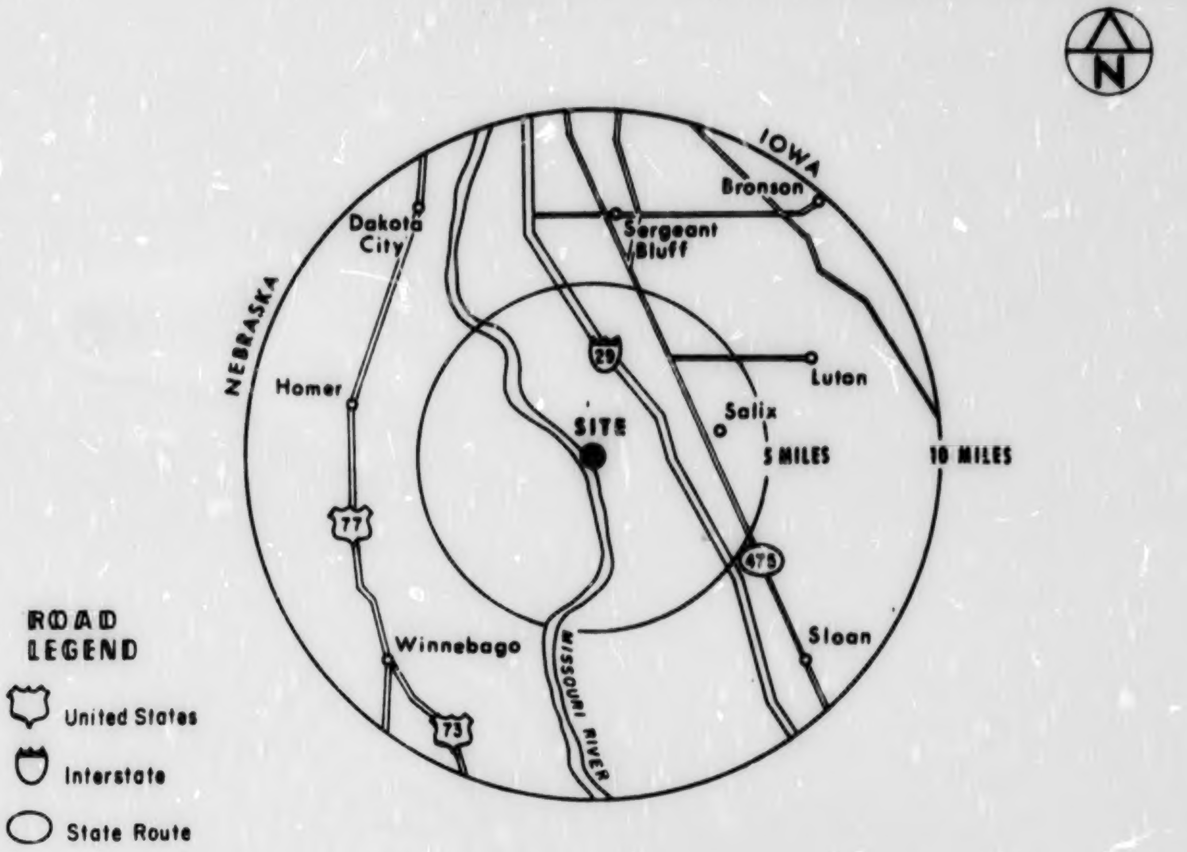
IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

PAST AND PROJECTED POPULATION
(COUNTIES WITHIN 10 MILES OF THE
NEAL SITE)

DATE: SCALE:

TABLE
III-1-3


N
IOWA
Bronson
Dakota City
Sergeant Bluff
NEBRASKA
29
Homer
Luton
Salix
SITE
5 MILES
10 MILES
77
475
Sloan
Winnebago
MISSOURI RIVER
73
ROAD LEGEND
United States
Interstate
State Route

PLACE	POPULATION	DISTANCE FROM SITE (miles)	DIRECTION FROM SITE
Salix	387	4	E
Sergeant Bluff	1,153	7	N
Homer, Neb.	457	7	W
Luton	50*	7	ENE
Dakota City, Neb.	1,057	8	NNW
Sloan	799	8	SE
Winnebago, Neb.	675	8	SW
Bronson	193	10	NE

* 1974 population estimate provided by Siouxland Interstate Metropolitan Planning Council (SIMPCO)

Source: U.S. Bureau of the Census
1970 Census of Population
Number of Inhabitants
PC (1) – A17 IOWA, Table 6

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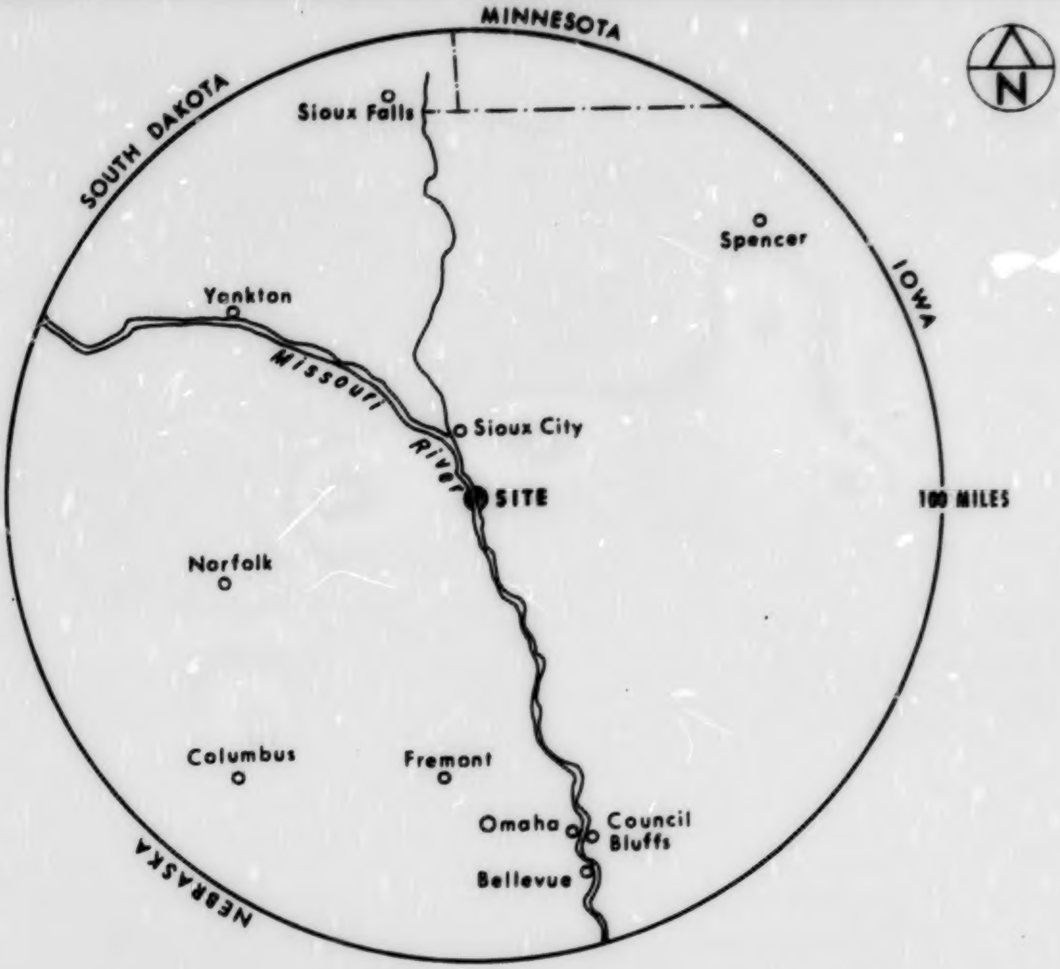
IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

POPULATION: PLACES WITHIN 10 MILES
OF PROPOSED SITE

EXHIBIT
III-I-1

DATE:
SCALE:


MINNESOTA
SOUTH DAKOTA
IOWA
NEBRASKA
N
Sioux Falls
Spencer
Yankton
Missouri River
Sioux City
SITE
100 MILES
Norfolk
Columbus
Fremont
Omaha
Council Bluffs
Bellevue

PLACE	DISTANCE FROM SITE (miles)	DIRECTION FROM SITE	1970 POPULATION	1960 POPULATION	% CHANGE
Sioux City, IOWA	14	N	85,925	89,159	-3.6
Fremont, NEB.	60	S	22,962	19,698	16.6
Norfolk, NEB.	60	WSW	16,607	13,640	21.8
Yankton, S.D.	65	NW	11,919	9,279	28.5
Omaha, NEB.	75	SSE	347,328	301,598	15.2
Council Bluffs, IOWA	75	SSE	60,348	55,641	8.5
Bellevue, NEB.	80	SSE	19,449	8,831	120.2
Columbus, NEB.	80	SW	15,471	12,476	24.0
Spencer, IOWA	85	NE	10,278	8,864	16.0
Sioux Falls, S.D.	90	NNW	72,488	65,466	10.7

SOURCE: U.S. Bureau of the Census
1970 Census of Population
Number of Inhabitants
U.S. Summary, PC(1)-A1, Table 31

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

CENTERS OF OVER 10,000 POPULATION
WITHIN 100 MILES OF PROPOSED SITE

DATE:
SCALE:

EXHIBIT
III-I-2

are located within a 100 mile radius of the proposed site. Sioux City is of most significance to the proposed site because of its high population (85,925 in 1970) and close proximity (14 miles). Sioux City, however, was the only listed city to experience a net loss of inhabitants (36 percent) from 1960 to 1970. Omaha, Nebraska, 75 miles south-southeast of the proposed site, is the largest city in the region. Over the same ten year period, its population increased 15.2 percent, to 347,328.

The 1974 population estimates for counties within 10 miles of the proposed site are presented in Table III-I-3. Woodbury County, with an estimated 103,800 people, is more populous than the other 3 counties combined. During the 1960's, Woodbury County's population declined by 4.4 percent as shown in Table III-I-2. A decline was registered in both urban and rural areas although the percentage drop was considerably greater in the rural sector.

The proposed site is located within Liberty and Lakeport townships which had a 1970 population of 1022 and 210, respectively (shown in Table III-1-4). Liberty is among the more heavily settled townships in Woodbury County. While the County experienced a 4.4 percent decline in population between the last two decennial federal censuses, Liberty township was the most stable among the twenty-four Woodbury County subdivisions with a decline of only 1 percent.

The components of population change of a community are births, deaths and migration. Migration, the least amenable to measurement and especially to forecasting, plays the most important role in population fluctuations. The components of population change in Woodbury County from 1960 to 1970 are given in Table III-I-5. During that decade, Woodbury County had a net loss of 4797 persons, equivalent to a decline of 4.4 percent. This compares to the state increase of 2.4 percent. The natural increase, which is defined as the excess of births over deaths, for the county was 10,463 persons or 9.7 percent while the state experienced a natural increase of 9.1 percent. Due to a heavy out-migration from the county (14.1 percent, or almost 1 out of 7 residents), the net change was a loss of 4.4 percent. The net change in the state's population was an increase of 2.4 percent because net migration was not significant enough to negate the gain in population due to natural increase.

As indicated in Table III-I-6, the median age in Woodbury County in 1970 was 28.8 years; 12.5 percent of the population was 65 years of age or over. These statistics are similar to those of the Sioux City urbanized area, the State of Iowa and the State of Nebraska, as well as to the two Nebraska counties in the immediate vicinity of the proposed site. Monona County, however, had a considerably older population with a median age of 36.9 years, and 16.9 percent of the population 65 years of age or over.

Minor Civil Division	1970	1960	Percent Change
Arlington township	1,639	1,602	+2.3
Banner township	818	788	+3.8
Concord township	828	657	+26.0
Floyd township	722	778	- 7.2
Grange township	302	343	–12.0
Grant township	372	426	–12.7
Kedron township	1,180	1,082	+9.1
Lakeport township	210	277	– 24.2
LIBERTY TOWNSHIP	1,022	1,032	- 1.0
Liston township	895	961	– 6.9
Little Sioux township	661	804	-17.8
Miller township	251	491	-48.9
Morgan township	330	421	-21.6
Moville township	336	441	-23.8
Oto township	541	644	-16.0
Rock township	754	1,020	-26.1
Rutland township	858	923	– 7.0
Sioux City city	85,925	89,159	– 3.6
Sloan township	1,086	1,056	+2.8
Union township	886	948	– 6.5
West Fork township	427	545	-21.7
Willow township	600	730	-17.8
Wolf Creek township	353	487	-27.5
Woodbury township	2,056	2,234	-8.8
Woodbury County	103,052	107,849	- 4.4

Source: U S Bureau of the Census
1970 Census of Population
Number of Inhabitants
PC(1) -A17 Iowa, Table 10

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

POPULATION OF WOODBURY COUNTY
SUBDIVISIONS, 1960 AND 1970

DATE: SCALE:

TABLE
III-1-4

	Woodbury County		Iowa	
	Number	Percent Change	Number	Percent Change
1960 Population	107,849		2,757.537	
Natural Increase	10,463	+9.7	251,431	+9.1
(Births)	(21,689)		(541,097)	
(Deaths)	(11,226)		(290,666)	
Net Migration	-15,260	-14.1	-183,592	-6.7
Net Change	– 4,797	–4.4	+66,839	+2.4
1970 Population	103,052		2,824,376	

Source: U S Bureau of the Census
1970 Census of Population
Components of Population Change of County, 1960-1970
P25 #461

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

COMPONENTS OF POPULATION CHANGE IN WOODBURY COUNTY, 1960 TO 1970

DATE: SCALE:

TABLE III-1-5

County	Population	Age Characteristics			Percent Rural	Native Pop. - Percent Residing In State of Birth	Persons 25 Yrs & Over - Median School Years Completed	Households	
		Median Age	Percent Under 18 Yrs	Percent 65 Yrs & Over				Number	Persons Per Household
Woodbury	103.052	28.8	34.6	12.5	15.5	70.0	12.3	32,854	3.04
Dakota (Neb)	13,137	26.0	38.7	10.1	39.7	50.4	12.1	3,910	3.30
Thurston (Neb)	6.935	27.4	38.9	12.4	100.0	83.2	11.2	2,036	3.34
Monona	12,069	36.9	32.3	16.9	72.8	82.1	12.1	4,134	2.87
Sioux City Urbanized Area	95,937	28.2	34.5	12.3	-	65.8	12.2	30,657	3.03
STATE OF IOWA	2.814,376	28.8	34.5	12.4	42.8	78.7	12.2	896,295	3.05
STATE OF NEBRASKA	1.483.493	28.6	34.2	12.4	38.5	72.3	12.2	473,902	3.02

Source: U S Bureau of the Census
1970 Census of Population
General Population Characteristics
PC(1)-B17 Iowa, Tables 16, 24 and
PC(1)-B29 Nebraska, Tables 20, 22, 35 and 36

U S Bureau of the Census
1970 Census of Population
General Social and Economic Characteristics
PC(1)-C17 Iowa , Tables 82, 83 and
PC(1)-C29 Nebraska, Table 43

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

SELECTED DEMOGRAPHIC CHARACTERISTICS,
1970: (COUNTIES WITHIN 10 MILES OF
THE NEAL SITE)

DATE:

SCALE:

TABLE
III-1-6

3. Population Projections

County population projections for 5-year intervals through 1990 were made available by the Iowa State Office of Planning and Programming and the University of Nebraska Bureau of Business Research and are listed in Table III-I-3. Woodbury County's population is expected to increase over the 15-year period ending in 1990. The population of Monona County is projected to increase at a slower rate, while Thurston County's population is anticipated to remain relatively stable. The population of Dakota County is also expected to increase.

J. SOCIAL AND ECONOMIC CHARACTERISTICS

The discussion of social and economic characteristics includes an analysis of educational attainment, residential moves, housing characteristics, incomes, and commutation. Most of the information used in this study was obtained from the U.S. Bureau of the Census, the Iowa Employment Security Commission, and the Iowa Crop Reporting Service. Areas examined are Woodbury and Dakota Counties (which comprise the Sioux City Standard Metropolitan Statistical Area); the two other counties within 10 miles of the site; and the Sioux City urbanized area.

1. Education

The level of education is an indicator of the socio-economic status of a community. A summary of educational levels for Woodbury County is shown in Table III-J-1. In 1970, persons 25 years of age and over residing in Woodbury County had achieved a relatively high level of educational attainment with a median number of 12.3 school years completed. This may be compared with 12.2 years for the median for the state and 12.1 years for the nation. In 1960 the median for both the county and state was 11.3 years of school completed. Both the county and the state, therefore, experienced substantial gains in the level of educational attainment during the intervening decade. Contributing heavily to this increase was the larger number of residents attending college during the 1960's and reaching adulthood by the 1970 census. High school graduates accounted for 59.3 percent of the county's adult population in 1970.

An opposite indicator of educational attainment is functional illiteracy. Functional illiteracy is measured as the number of persons, 25 years old and over, who have completed less than 5 years of school. In 1970, 2.6 percent of Woodbury County's population was in this category. This is higher than the state's figure of 1.9 percent, but substantially below the national total of 5.5 percent.

Among the counties within 10 miles of the proposed site, Woodbury had the highest median number of school years completed, as shown in Table III-I-6 in the previous section. The median for Thurston County, Nebraska was considerably lower with 11.2 years completed while those for Dakota County, Nebraska and Monona County were both 12.1 years.

2. Residential Moves

The native population, as measured by the percent of the 1970 population residing in their state of birth, was 70 percent for residents of Woodbury County, as shown in Table III-I-6. Table III-J-2 presents information regarding residential moves for residents of counties within 10 miles of the proposed site. Of the Woodbury County residents in 1970, almost 40 percent had moved since 1965; among those who changed residence, about 60

	1970		
	Woodbury County		Iowa
	Number	Percent	Percent
Total Persons, 25 Years old and over	55.908	100.0	100.0
No School Years Completed	555	1.0	0.6
Elementary			
1 to 4 Years	877	1.6	1.3
5 to 7 Years	3.011	5.4	5.7
8 Years	8,399	15.0	18.5
High School:			
1 to 3 years	9,894	17.7	15.0
4 Years	20,932	37.4	38.7
College:			
1 to 3 Years	6.733	12.0	11.1
4 Years or More	5,507	9.9	9.1
Median School Years Completed		12.3	12.2

Source: U S Bureau of the Census
1970 Census of Population
General Social and Economic Characteristics
PC(1)-C17 Iowa, Tables 46 and 120

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IOWA PUBLIC SERVICE CO. - NEAL UNIT 4

WOODBURY COUNTY EDUCATIONAL ATTAINMENT

DATE: SCALE:

TABLE III-J-1

County	Total	Same Residence	Residence in 1965					
			Difference Residence in U S					
			Number	Percent of Total	Same County	Percent of Total	Different County	Percent of Total
Woodbury	94,647	53,610	37,638	39.8	23,265	24.6	14,373	15.2
Dakota (Neb)	11,791	6,545	4,814	40.8	2,352	19.9	2,462	20.9
Thurston (Neb)	6,343	4,541	1,464	23.1	786	12.4	678	10.7
Monona	11,274	7,206	3,739	33.2	1,954	17.3	1,785	15.8
STATE OF IOWA	2,591,320	1,479,159	1,015,866	39.2	580,843	22.4	435,023	16.8
STATE OF NEBRASKA	1,362,316	734,027	559,209	41,0	295,308	21.7	263,901	19.4

Source: U S Bureau of the Census
1970 Census of Population
General Social and Economic Characteristics
PC(1)-C17 Iowa, and
PC(1)-C29 Nebraska, Tables 45 and 119

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

RESIDENTIAL MOVES, 1965 TO 1970
(COUNTIES WITHIN 10 MILES OF
THE NEAL SITE)

DATE:
SCALE:

TABLE
III-J-2

percent had moved within the county. These figures are quite similar to those for the State of Iowa as a whole. Among the four counties in the immediate study area, Thurston County, Nebraska, had an especially stationary population with only 23.1 percent having changed their residences since 1965.

3. Housing Characteristics

Several 1970 housing characteristics of the four counties in the immediate site vicinity and the Sioux City urbanized area are presented in Table III-J-3. More than 99 percent of all housing units in these four counties are year-round units. Of these year-round housing units in Woodbury County, only 6.3 percent lacked some or all plumbing facilities while the comparable figure for the state was 7.5 percent and for Thurston County, Nebraska, it was 22.1 percent. The median value of $12,900 of owner occupied housing units in Woodbury County was higher than that in the other three counties and also exceeded the state averages. More than 1500 housing units in Woodbury County in 1970 were vacant and available for sale or rent.

For the Sioux City Urban Area, under conditions of moderate growth, forecasts of housing and land requirements through the year 2000 have been prepared by the Siouxland Interstate Metropolitan Planning Council (SIMPCO). As presented in Table III-J-4, 2,537 acres in the area require development to support 11,870 new housing units, both single and multi-family types.

4. Economy

According to the Iowa Crop Reporting Service located in Des Moines, Iowa, livestock in Woodbury County produced more total cash receipts than did crops in 1973. Cattle and hogs were responsible for similar cash receipts with dairy products following. Corn, soybeans and oats are the main crops. Woodbury County is characterized by the Iowa Crop Reporting Service as a consistently good producing agricultural county.

In 1970 there were 39,179 employed persons 16 years of age and over in Woodbury County. The figures for Monona, Dakota, and Thurston Counties were, respectively, 4251, 4889 persons, and 2421 persons. Information regarding employment by industry to 1970 is presented in Table III-J-5. Due to the influence of Sioux City on the character of Woodbury County, the retail trade employed 19.6 percent of those working, and manufacturing accounted for 17.4 percent. Agriculture, forestry, and fisheries together accounted for 4.7 percent or 1842 persons. In Dakota County, Nebraska manufacturing and the retail trade also employed the highest percentages of workers, with 23.2 percent and 19.5 percent, respectively. Agriculture, forestry, and fisheries together accounted for 9.5 percent of those employed in Dakota County. Monona and Thurston Counties, Nebraska, both exhibited markedly different industrial profiles from those of Woodbury and Dakota Counties, Iowa. In these counties, agriculture, forestry

County	Total Housing Units	Year-Round Housing Units							
		Total	Percent Lacking Some or All Plumbing Facilities	Owner-Occupied		Renter-Occupied			Vacant for Sale only or For Rent
				Total	Median Value (dollars)	Total	Percent Lacking Some or All Plumbing Facilities	Median Contract Rent (dollars)	
Woodbury	35,127	35,093	6.3	22.816	12,900	10,018	11.4	72	1,572
Dakota (Neb)	4,174	4,171	7.4	2,753	11,800	1,158	8.4	76	152
Thurston (Neb)	2,211	2,207	22.1	1.239	7.400	794	28.2	51	67
Monona	4,511	4,478	4.5	2.908	8,100	1,225	11.3	49	110
Sioux City Urbanized Area	32,626	32,614	5.4	21,200	13,200	9,457	11.6	74	1,547
STATE OF IOWA	964,060	954,801	7.5	642.676	9,900	253.635	9.6	77	28,070
STATE OF NEBRASKA	515.069	511.891	6.1	314.600	12,400	133,279	7.6	77	17,672

Source: U S Bureau of the Census
1970 Census of Population
General Housing Characteristics
HC(1) -A17 Iowa and
HC(1) -A29 Nebraska. Tables 2, 3, 4 and 29

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

HOUSING CHARACTERISTICS, 1970
(COUNTIES WITHIN 10 MILES OF
THE NEAL SITE)

DATE:

SCALE:

TABLE
III-J-3

			New Housing Units			Additional Acres to be Developed		
Year			1980	1990	2000	1980	1990	2000
Housing Type	**Lot Area**	**Gross Acres/ Housing Unit**						
Single Family								
Low	20,000	.662	145	302	474	96	200	314
Medium	8,000	.293	1,501	2,650	2,970	440	776	870
High	6,600	.254	732	1,590	2,492	186	404	633
Multi Family								
Low	4,000	.153	367	1,514	2,374	56	232	363
Medium	2,800	.119	732	1,135	2,374	87	135	283
High	1,000	.062	183	379	1,186	11	23	74
Totals			3,660	7,570	11,870	876	1,770	2,537

Source: Siouxland Interstate Metropolitan Planning Council (SIMPCO), Economic Report, 1972.

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

MODERATE FORECAST OF GROSS NEW RESIDENTIAL HOUSING AND LAND REQUIREMENTS
SIOUX CITY URBAN AREA

DATE:
SCALE:

TABLE
III-J-4

	Woodbury County		Dakota County		Thurston County		Monona County		Urbanized Area* Sioux City	
Industry	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Agriculture, Forestry, and Fisheries	1,842	4.7	463	9.5	682	28.2	1,225	28.8	325	0.9
Mining	36	0.1	0	0.0	0	0.0	0	0.0	36	.1
Construction	2,206	5.6	330	6.7	115	4.8	307	7.2	2,030	5.4
Manufacturing	6,819	17.4	1,136	23.2	315	13.0	259	6.1	6,977	18.7
Transportation and Communications	2,439	6.2	298	6.1	84	3.5	155	3.6	2,474	6.6
Utilities and Sanitary Services	655	1.7	85	1.7	31	1.2	71	1.7	653	1.8
Wholesale Trade	2,707	6.9	202	4.1	38	1.6	86	2.0	2,749	7.4
Retail Trade	7,678	19.6	952	19.5	316	13.0	808	19.0	7,612	20.4
Banking and Finance	2,063	5.3	260	5.3	50	2.1	138	3.2	2,119	5.7
Education	3,175	8.1	273	5.6	222	9.2	378	8.9	2,819	7.5
Professional Services Except Medical	769	2.0	84	1.7	29	1.2	60	1.4	736	2.0
Health, Welfare and Related Services	3,534	9.0	275	5.6	242	10.0	251	5.9	3,455	9.3
Other Services	3,452	8.8	406	8.3	158	6.5	307	7.2	3,570	9.6
Public Administration	1,794	4.6	125	2.6	139	5.7	206	4.8	1,693	4.5
Total	39,179	100.0	4,889	99.9	2,421	100.0	4,251	99.8	37,248	100.0%

1969 per capita income:
$2,933

Source: U.S. Bureau of the Census
1970 Census of Population
General Social and Economic Characteristics
PC(1)-C17 Iowa and PC(1)-C29 Nebraska Table 123,87, 89

*General Social & Economic Characteristics Iowa PC(1)-C17

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

EMPLOYED PERSONS 16 YEARS OF AGE AND OLDER, BY INDUSTRY, 1970
(COUNTIES WITHIN 10 MILES OF THE NEAL SITE)

DATE:

SCALE:

TABLE
III-J-5

and fisheries employed a plurality of the working force, amounting to more than 28 percent. In Monona County, retail trade and education were the next largest industries (19 percent and 8.9 percent, respectively) while in Thurston County retail trade and manufacturing both accounted for 13.0 percent.

Table III-J-6 presents forecasts, under conditions of moderate growth in the Sioux City urban area, of employment by industry groupings through the year 2000.

In Woodbury County, taxable payrolls during the first quarter of 1972 amounted to $51,077,000, which represented a 10.2 percent increase over the previous year (Table III-J-7). The larger role of agriculture in Monona and Thurston Counties is reflected in the relatively low taxable payrolls in these two counties. Thurston County did, however, experience a 20.3 percent increase in taxable payrolls during 1972 (Table III-J-7).

5. Occupation Characteristics, Incomes, and Commutation

The occupational groups of the employed labor forces in each of the four counties within 10 miles of the site are shown in Table III-J-8. Data in Table III-J-9 indicate generally higher earnings in Woodbury County than in the other three counties studied. Earnings for comparable occupations were generally lowest in the Thurston County, Nebraska, which is entirely within the boundaries of the Omaha and Winnebago Indian Reservations.

Per capita and family income in Woodbury County was typical of the State of Iowa (Table III-J-10) while levels for Monona County were generally lower. The per capita income in Woodbury County was $2886 in 1969, and the median family income was $9035 in 1970. Among the 25,863 families in Woodbury County, 9.2 percent had incomes below poverty level ($3,259), while 16 percent had incomes of $15,000 or more. Monona County's family income was lower than Woodbury County. Thurston County had significantly lower per capita and family income than other counties in the study area.

According to data supplied by the Iowa Employment Security Commission (IESC), the January 1976 unemployment rate in the Sioux City SMSA (comprising of Woodbury and Dakota Counties) was 3.8 percent*, or less than half the national average. Unemployment has, in fact, decreased steadily over the past three annual surveys. U.S. Census Bureau statistics, arrived at by a different methodology, show higher levels of unemployment for this area. However, these are still relatively low rates of unemployment and can be ascribed to three characteristics of the State of Iowa as a whole:

- Agriculture, a relatively non-volatile industry, is at the base of the state's economy.

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* Not seasonally adjusted. Local unemployment rates are currently undergoing a data revision process which will, in the case of Sioux City, cut the rate by about 0.5%. (Iowa Unemployment Security Commission, telephone contact, March 31, 1976).

	Industry Grouping	Year		
		1980	1990	2000
1	Agriculture	38	43	47
2	Construction	2,078	2,153	2,275
3	Meat Processing	5,422	5,850	6,402
4	Other Food Manufacturing	1,448	1,430	1,661
5	Other Manufacturing	6,623	8,865	11,323
6	Transportation, Communications and Utilities	3,502	4,005	4,616
7	Wholesale Trade	3,565	3,954	4,436
8	Retail Trade	8,618	9,789	11,332
	Trade Sub-Total (7 & 8)	(12,183)	(13,743)	(15,768)
9	Finance, Insurance and Real Estate	2,357	2,735	3,194
10	Education	2,137	2,511	2,957
11	Medical Services	3,203	3,666	4,221
12	Other Services	4,604	5,453	6,472
	Services Sub-Total (10, 11, 12)	(9,944)	(11,630)	(13,650)
13	General Government	2,052	2,309	2,630
	TOTALS	45,647	52,763	61,566

Source: Siouxland Interstate Metropolitan Planning Council (SIMPCO), Economic Report, 1972.

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IOWA PUBLIC SERVICE CO. - NEAL UNIT 4

MODERATE FORECAST OF TOTAL
EMPLOYMENT BY INDUSTRY GROUPINGS
SIOUX CITY URBAN AREA

DATE:

TABLE
III-J-6

County	1972 Number of Employees, Mid-March Pay Period	1972 Taxable Payrolls, Jan-Mar ($1000)	1971 Number of Employees, Mid-March Pay Period	1971 Taxable Payrolls, Jan-Mar ($1000)	Percent Change, Taxable Payrolls, First Quarters 1971-1972
Woodbury	32,533	51,077	31,181	46,355	10.2
Dakota (Neb)	4,281	7,269	4,323	6,954	4.5
Thurston (Neb)	1,076	1,241	943	1,031	20.3
Monona	1,382	1,349	1,302	1,254	7.6
STATE OF IOWA	683,626	1,127,543	660,427	1,010,141	11.6
STATE OF NEBRASKA	379,781	579,520	361,041	511,269	13.3

*Excludes government and railroad employees, self-employed persons, farm workers, and domestic service workers.

Source: U S Bureau of the Census
County Business Patterns, 1972
CBP-72-17 Iowa and
CBP-72-29 Nebraska, Table 1F

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

EMPLOYMENT AND PAYROLL, FIRST
QUARTER 1971 AND 1972:(COUNTIES WITHIN
10 MILES OF THE NEAL SITE)

DATE:

SCALE:

TABLE
III-J-7

Occupation	Woodbury County		Dakota County		Thurston County		Monona County	
	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Professional, Technical	4,983	12.7	395	8.1	257	10.6	418	9.8
Managers and Administrators, Non-Farm	4,281	10.9	438	9.0	175	7.2	400	9.4
Sales	3,376	8.6	358	7.3	80	3.3	254	6.0
Clerical	6,429	16.4	579	11.8	273	11.3	446	10.5
Craftsmen, Foremen	4,900	12.5	738	15.1	166	6.9	451	10.6
Operatives, Non-Transport	3,959	10.1	680	13.9	192	7.9	225	5.3
Transport Equipment Operatives	1,637	4.2	278	5.7	92	3.8	174	4.1
Laborers, Non-Farm	1,898	4.8	231	4.7	173	7.1	200	4.7
Farmers, Farm Managers	1,318	3.4	363	7.4	505	20.9	952	22.4
Farm Laborers, Farm Foremen	386	1.0	80	1.6	161	6.7	226	5.3
Service	5,545	14.2	655	13.4	294	12.1	411	9.7
Private Household	467	1.2	94	1.9	53	2.2	94	2.2
Total	39,179	100.0	4,889	99.9	2,421	100.0	4,251	100.0

Source: U.S. Bureau of the Census
1970 Census of Population
General Social and Economic Characteristics
PC(1)-C17 Iowa and PC(1)-C29 Nebraska Table 122

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

EMPLOYED PERSONS 16 YEARS OF AGE AND OLDER, BY OCCUPATION, 1970
(COUNTIES WITHIN 10 MILES OF THE NEAL SITE)

DATE:

SCALE:

TABLE
III-J-8

Occupation	Woodbury Co. Median Earnings		Dakota Co. (Neb) Median Earnings		Thurston Co. (Neb) Median Earnings		Monona Co. Median Earnings	
	Males	Females	Males	Females	Males	Females	Males	Females
Professional, Managerial, and **Kindred Workers**	$10,282		$9.547	-	$6.897	-	$9,071	-
Craftsmen, Foremen, and **Kindred Workers**	7.633		7.492	-	5.300		6.433	-
Operatives, including Transport	6.615	$3.152	6.880	$3.366	4,742	$3,407	5,545	--
Laborers, except Farm	4.313		6.364		3.800	--	4.250	–
Farmers and Farm Managers	6.153		5.741	--	4.635		5.892	–
Farm Laborers and Foremen	3.492	-	2.893	-	2.939		2,662	–
Clerical and Kindred Workers		3.552	--	3.284		2.065	--	$2,254

Source: U S Bureau of the Census
1970 Census of Population
General Social and Economic Characteristics
PC(1)-C17 Iowa and
PC(1)-C29 Nebraska, Table 122

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

MEDIAN EARNINGS OF PERSONS IN EXPERIENCED CIVILIAN LABOR FORCE FOR SELECTED OCCUPATION GROUPS, 1969: (COUNTIES WITHIN 10 MILES OF THE NEAL SITE)

DATE:

SCALE:

TABLE
III-J-9

County	Per Capita Income (dollars)	Families				Civilian Labor Force – Percent Unemployed
		Total Number	Median Income (dollars)	Percent Less Than Poverty Level	Percent $15,000 or More	
Woodbury	2,886	25,863	9,035	9.2	16.1	4.6
Dakota (Neb)	2,593	3,273	8,557	9.5	11.3	2.5
Thurston (Neb)	1,875	1,672	6,075	20.2	5.4	1.3
Monona	2,603	3,273	6,975	12.3	12.4	3.9
STATE OF IOWA	2,894	713,490	9,018	8.9	16.2	3.5
STATE OF NEBRASKA	2,814	372,430	8,564	10.1	14.9	2.7

Sources: U S Bureau of the Census
1970 Census of Population
General Social and Economic Characteristics
PC(1) -C17 Iowa and
PC(1) -C29 Nebraska. Tables 44, 68, and 124

U S Bureau of the Census
1970 Census of Population
General Population Characteristics
PC(1) -B17 Iowa and
PC(1) -B29 Nebraska. Table 22

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IOWA PUBLIC SERVICE Co. – NEAL UNIT 4

PER CAPITA INCOME, 1969 AND FAMILY INCOME AND UNEMPLOYMENT, 1970
(COUNTIES WITHIN 10 MILES OF THE NEAL SITE)

DATE:

SCALE:

TABLE
III-J-10

- Much of the industry is also correspondingly stable, e.g., farm machinery manufacturing and food processing.

- The state is experiencing a net out-migration which tends to diminish unemployment.

In 1970, among workers residing in Woodbury County, 7.2 percent worked outside that county (Table III-J-11). About 10 percent of Monona County's workers commuted outside the county to their jobs. Comparable figures for Thurston and Dakota Counties, Nebraska were 12.0 percent and 40.4 percent.

Future employment rates in the Sioux City Urban Area under moderate growth conditions have been forcasted by SIMPCO and are presented in Table III-J-12. On the basis of these data, a steady increase in the percent of population employed and the labor force participation rate is expected through the year 2000.

County	All Workers	Worked In County of Residence	Worked Outside County of Residence	Place of Work not Reported	Percent of Reported Total Working Outside of County
Woodbury	38,590	34,024	2,621	1,945	7.2
Dakota (Neb)	4,857	2,722	1,843	292	40.4
Thurston (Neb)	2,481	1,941	264	276	12.0
Monona	4,201	3,425	394	382	10.3

Source: U S Bureau of the Census
1970 Census of Population
General Social and Economic Characteristics
PC(1)-C17 Iowa and
PC(1)-C29 Nebraska, Table 119

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A PUBLIC SERVICE Co. - NEAL UNIT 4

PLACE OF WORK, 1970:(COUNTIES WITHIN 10 MILES OF THE NEAL SITE)

DATE:

SCALE:

TABLE
III-J-11

	Year 1980	 1990	 2000
Employment (FTE)*	45,650	52,760	59,480
Percent of Population Employed	39.0	41.0	42.0
Total Population	117,000	128,700	141,600

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[*] FTE - Full Time Employment

Source: Siouxland Interstate Metropolitan Planning Council (SIMPCO), Economic Report, 1972.

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

MODERATE POPULATION AND EMPLOYMENT FORECASTS,
SIOUX CITY URBAN AREA

DATE:

SCALE:

TABLE
III-J-12

IV - ENVIRONMENTAL IMPACT OF THE PROPOSED PROJECT

A. CONSTRUCTION

1. Impact on Local Socio-Economics

The development of the proposed Neal Unit 4 is not anticipated to introduce a major or abrupt alteration in the socio-economic character of the area. The overall effect of the proposed action on both a local and regional basis is projected to be consistent with the area's existing character as well as recent trends and developments.

From an economic viewpoint, the proposed project will have a generally beneficial, though not substantial, impact on the Sioux City Standard Metropolitan Statistical Area (SMSA); ie, the area consisting of Woodbury County, Iowa, and Dakota County, Nebraska. These benefits include the creation of new jobs during the construction of the project, and secondary economic activities resulting from the project.

To evaluate construction impacts, present socio-economic developments in the area were examined and related to the experience gained from construction activities which occurred in the same general vicinity for the existing Neal Units 1, 2 and 3.

a. Employment and Labor Force

The primary effect of construction on employment and the labor force is expected to occur within the Sioux City SMSA because the proposed project will be located only 14 miles from the center of the Sioux City urbanized area. The project development would be in keeping with employment patterns for the area since the construction industry has generally accounted for more than 5 percent of the labor force.

A number of construction workers for the plant will be available because of two factors. First, because of the recent completion of George Neal Unit 3 in December 1975, a number of the workers required for the construction of George Neal Unit 4 will already be in the area. Construction of George Neal Unit 3 required an average of 350 to 400 workers. Second, based on 1970 U.S. employment statistics,[1] a total of 5,727 construction workers are available within an approximately ninety minute drive of the site.

The average unemployment rate between 1970 and 1976 for construction workers in the State of Iowa has been approximately 10 percent[2]. This rate along with the knowledge that George Neal Unit 3 has just been completed indicates there should be approximately 600 construction workers available in the area to work on George Neal Unit 4.

Construction employment for the proposed project is scheduled to extend over an approximately 3-1/2 year period. Construction began in March 1975, and trial operation is scheduled for September 1978. The projected average construction work force on the site is 700 workers and a maximum of 1,200 workers.

b. Housing and Relocation

Based on the projected work force it will be necessary during various phases of construction to employ relocated workers. It is estimated that anywhere from 100 to 700 workers will relocate to the Sioux City area during various periods of construction. Assuming an average family size to be 3.1 persons[3], relocation would result in a maximum increase in population of 2,170 persons. The derived population increase may be higher than would actually be experienced, since many relocated construction workers should be staying in the area for a relatively short period and are not expected to bring families. Compared to the population of the Sioux City SMSA (118,600 in 1974), this influx will result in a maximum increase of 1.8 percent. Therefore, construction worker immigration should have little, if any, adverse impact on housing and social services in the area. In addition, because of the higher levels of housing available in the Sioux City SMSA than in adjacent rural counties, no adverse impact or pressures are predicted for these counties.

c. Other Economic Factors

Some important considerations include: the economic benefits resulting from construction activities; the subsequent economic activity resulting from secondary or "multiplier" effects; and, the growth in the local tax base, including those resulting directly and those resulting indirectly from increased payrolls and business activity.

The potential taxes resulting from the construction of the proposed project will accrue to both state and local government. The beneficial impact of the proposed project is augmented by the fact that construction will not cause a substantial temporary loss in annual property tax due to dislocation of houses or businesses.

Neal Unit 4 will have no effect on the economic costs to the consumer during construction because the Iowa Commerce Commission does not allow construction work in progress to become a part of the rate base.

The unit has a projected heat rate and operating cost equivalent to the Neal 3 unit. The budgeted installed cost of the unit is $276,000,000. The increased burden to the consumers of all the partners in the project based on today's taxes, cost of money, depreciation rate, and allowable rate of return on investment amounts to $41,400,000 per year. This would be realized from increased consumption by existing consumers, increase in number of consumers, and individual company related savings due to decreased operation of less efficient generating units.

d. Community Facilities and Services

The construction of the proposed project is expected to have an impact on community facilities and services. The majority of construction employees are expected to commute to the project site from the nearby Sioux City area. Interstate 29, which extends south from Sioux City, is located approximately 2-1/2 miles east of the proposed site. A secondary access road runs from Interstate 29 to the site vicinity.

The traffic resulting from construction activities will generally be of two types: construction employees commuting to and from work, and road usage by construction trucks and equipment, which will be on an intermittent basis. To a large extent trucks and equipment will be limited to the project site while commuting traffic will be on regional routes and project access roads.

During the workday when construction workers are at the site, support facilities and services required from local communities are anticipated to be minimal. Based on past experience at Neal Units 1, 2 and 3, normal community services, including police, fire, health facilities, and similar public and semi-public activities should not be significantly affected.

Due to the sparsity of workers that are expected to reside near the site, the effects on local school enrollment by the proposed project is estimated to be small. Waste disposal and operation of sanitary facilities will be accomplished in accordance with applicable federal, state, and local standards.

2. Impact on Land Use and Aesthetics

Environmental disturbances resulting from construction include: the disruption of local transportation during construction; displacement of land from agricultural production, excavation and stockpiling requirements; and reduction of the scenic value in the area.

The site is located at the southern end of several existing industrial developments in a region generally surrounded by agricultural lands. According to current zoning practices, with the presence of the Port Neal Industrial District and the existing Neal Station to the north, the addition of Neal Unit 4 will not conflict with present land use patterns or recent development trends.

Since the site is just south of the existing power plant complex, additional facilities for vehicles and rail transportation are necessary. Existing roads are sufficient for construction access to the site. About 1-1/2 miles of rail spur have been constructed. Due to the generally low population density in the vicinity of the proposed project, and the presence of the Port Neal Industrial District, the effects of noise, dust, and smoke disturbances from construction and transportation vehicles should not be significant.

Construction of the proposed project has displaced an area of land most of which was in agricultural production. The 415 acres of cropland on the site constituted less than 0.1 percent of the total agricultural land in Woodbury County.

The construction of the proposed project will have no direct or indirect effect on properties listed in the National Register of Historic Places and the National Register of Natural Landmarks. No known historic or archaeological sites will be affected by the project. The seven sites of historical or archeological interest in the Dakota-Woodbury County region are each a minimum of 7 miles away from the proposed location, and there are no reported historic or archaeological sites in the immediate vicinity of the proposed project.

The greatest impact on existing land use and features will occur during construction. During construction operations, areas will be excavated, earth will be stockpiled, construction materials stored, and protective fencing erected. These construction activities will initiate a temporary impact both physical and visual on the site area. To mitigate the adverse visual and other negative environmental consequences associated with construction, a program of specific practices and safeguards will be adopted by the construction contractor. These practices include:

- Soil and water conservation procedures, including the retention and protection of natural vegetation wherever possible and the removal and appropriate treatment of top soil during construction.
- Development of appropriate temporary ground cover and the reduction of soil erosion by minimizing the duration of soil exposure.
- Dust control procedures, including the water sprinkling of roads and construction areas, where appropriate.
- Appropriate management, removal and disposal of construction debris and unsightly materials.
- Compliance with state and local safety and health regulations, including statutory and administrative regulations which are applicable to the project activities.

- Permanent landscaping and planting of appropriate vegetation consistent with the precepts of a program for landscaping and horticultural practices.

3. Impact on Water

High infiltration rates occur at the plant site (as noted in Table III-A-1 the maximum infiltration rate ranges from 2 to 20 inches/hour). Therefore, since these rates are greater than 5 inches/24 hours (equal to the 10 year-24-hour rainfall event), it is estimated that no runoff will result due to construction activities.

Construction practices, moreover, are planned to minimize and inhibit soil erosion. These practices are:

- Minimizing cleared areas
- Avoiding steep slopes during grading operations
- Establishing plant cover as rapidly as possible after grading

Specific practices to be followed during construction of the intake and discharge structures are as follows:

- Excess concrete from the construction of the intake and discharge structures and the cleaning of concrete truck's chutes will not be discharged into the river.
- All areas disturbed along the bank during construction will be protected against soil erosion.
- Measures will be employed to prevent spillage of oils, fuels, or other types of hazardous materials and to keep these materials from entering the river during or after construction.
- In order to protect water quality and aquatic life, all construction activities will be accomplished in a manner to minimize turbidity.
- Debris will not be left on shore after cleaning operations to prevent the possibility of its entering the waterway.
- The excavated material not used for backfill will not be placed in the river or in a wetland area.

4. Impact on Land

a. Effects on Biological Communities of Site Area

i. Removal of Vegetation

The areas of natural vegetation which have been cleared for plant construction are shown in Exhibit IV-A-1. These areas consist of 4 acres of riparian shrub, 24 acres of sand dune border, and 6 acres of cottonwood forest. The remaining area to be cleared consists of approximately 415 acres of cropland.

The direct effects of construction will result in the loss of animals having restricted ranges or those which are sedentary (e.g., amphibians, reptiles, some small mammals, and most invertebrates). These animals will probably be eliminated because of clearing, excavating, grading and filling operations.

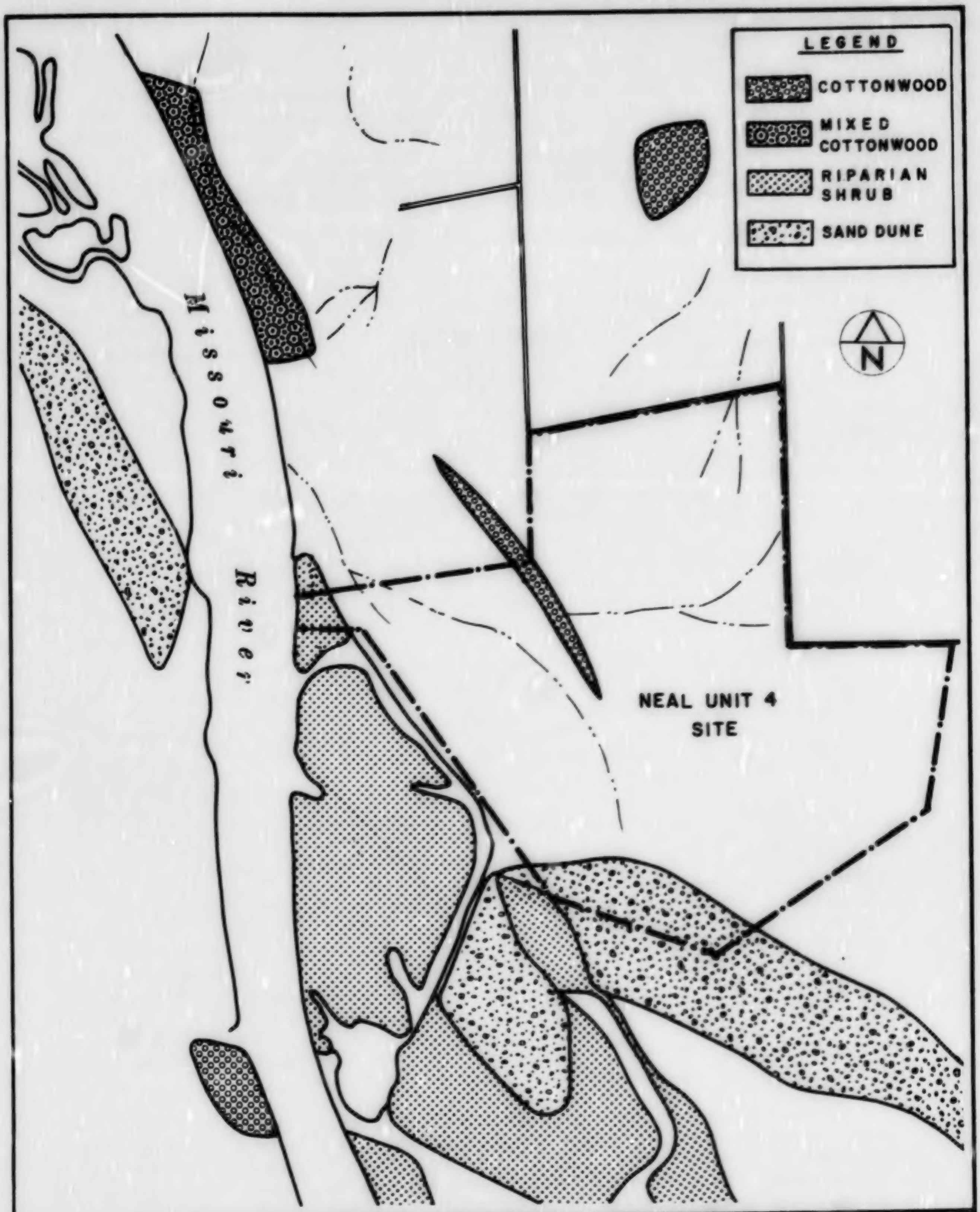
Larger mammals such as deer and coyotes and most birds will emigrate to adjacent undisturbed habitats. The animals not suffering mortality from predation during migration may utilize temporary habitats. However, since most habitats are at maximum carrying capacity prior to migration, the populations of these animals will decrease and revert back to the pre-migration population size after winter kills and predation. Therefore, the number of larger mammals and birds will be reduced as a result of construction.

Removal of riparian shrub, including wetlands, will eliminate the habitats of: deer dependent upon the cottonwood thickets for shelter and winter browse: pheasants which roost in the thickets and feed in the dry grassy areas: and, waterfowl which feed on the emergent aquatic plants of the partially inundated zones. The removal of cottonwood trees bordering a section of stream located within the site will represent a loss of habitat for deer, rabbits, pheasants and squirrels and therefore a loss in population numbers.

The direct impact of construction on wildlife will be severe but highly localized. Because of the small area of natural vegetation found on the proposed site, reductions in densities of game species and other wildlife resulting from vegetation removal are expected to be small.

Discontinuation of agricultural practices on the remaining 415 acres of the proposed site will reduce food supply for wildlife on the site and surrounding region. The Iowa State Conservation Commission owns a large refuge and state game management area south of the site (see Exhibit III-G-1) which includes cropland and many cover types.[5]

Iowa Public Service, in conjunction with the Iowa State Conservation Commission, has planted some vegetation for food and cover for wildlife at the site with a shelterbelt. The


LEGEND
COTTONWOOD
MIXED COTTONWOOD
RIPARIAN SHRUB
SAND DUNE
N
Missouri River
NEAL UNIT 4 SITE

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

NATURAL VEGETATION OF
NEAL UNIT 4 SITE

DATE:
SCALE:

EXHIBIT
IV - A - 1

shelterbelt has been planted along the perimeter of the site. It covers approximately 33 acres and is about 110 feet wide by 12,900 feet long. The belt consists of russian olive, ponderosa pine, red cedar, honey suckle, redosier, dogwood, native plum, soft maple and cottonwood. It will provide food, nesting sites, and protective cover for many kinds of wildlife.[6]

ii. Construction Activities

The increased presence of humans and the activities associated with plant construction may inhibit certain wildlife species from utilizing habitat adjacent to the site, such as the Browns Lake and Snyder Bend areas which are between one-half and three miles from the site. Construction noise may cause many of the more mobile species of wildlife to emigrate temporarily from areas adjacent to the noise sources. This avoidance behavior could restrict their access to food or shelter and, therefore, adversely affect their survival.[7] Breeding and feeding near construction areas is also expected to be less than in areas outside of hearing distance of the construction noise. Animals relying on auditory signals for courtship and mating, and for detecting prey and predators, will be affected by increased noise levels if they remain near the noise source. Some animals may adapt to noise produced during the construction phase of the project and utilize areas adjacent to construction noise sources.[8]

It has been observed that sparrows, blackbirds, and quail utilize open field habitat adjacent to power plant construction sites but flush when earth movers, bulldozers, or personnel come within the species flushing distance. Construction traffic can be expected to result in an unquantifiable increase in road kills of mammals, amphibians, and reptiles.

b. Effects on Regional Terrestrial Ecosystem

The assessment of plant construction impacts on the regional terrestrial ecosystem must consider the uniqueness of removed or disrupted vegetation types, the segmentation or separation of natural terrestrial areas, and the interference with particularly productive communities. The four vegetation types affected by site preparation activities are: sand dunes; riparian shrub; cottonwood forest; and cropland. Because the latter three types, as depicted in Exhibit III-F-1, are common, the loss of riparian shrub, cottonwood forest, and cropland is not likely to significantly alter the diversity of vegetation and wildlife habitat types in the regional ecosystem.

Most of the plant communities of the type found on the site are not unique to the region. However, the sand dune areas represent a relatively unique terrestrial community. The area destroyed by site construction, however, is small and is primarily a transition between sand dune and shrub woods.

The effect of plant construction on regional productivity is unquantifiable. As described above, parts of the productive riparian shrub zone of Snyder Bend may experience a decrease in wildlife utilization as a result of the area's close proximity to Neal Unit 4. Behaviorally wary species which rely to some extent on vegetative cover along the river's shore, such as deer, beaver, and mink, may be affected by plant construction and operation. There is some evidence that wintering bald eagles in the Snyder Bend area avoid present construction activities by flying along the western side of the Missouri River when foraging past the site.[9]

While the area of habitat affected by Neal Unit 4 is small in comparison with the total amount of these habitats which exist in the region surrounding the site, the loss of approximately 450 acres of vegetation and wildlife habitat for industrial use, nevertheless, represents a small but negative incremental impact on the terrestrial ecosystem of the Missouri River valley. Construction of Neal Unit 4 in the Port Neal Industrial District extends into agricultural and natural terrestrial communities. This industrial district, with the addition of Neal Unit 4, will border a large block of relatively undisturbed habitat on the east side of the Snyder-Winnebago Bends. This block will therefore not be divided into smaller segments.

c. Effects on Soils

Conversion of agricultural land to impervious buildings and pavements causes an increase in runoff because precipitation is prevented from soaking into the soil. In addition, soil is compacted by the passage of vehicles and cannot infiltrate precipitation as rapidly as undisturbed soil. In both situations the impact effect is a greater amount of runoff in a shorter time than would occur on the undisturbed soil. For the proposed site, however, this impact should not be great for two main reasons. First, the terrain is relatively flat which is not conducive to rapid runoff. Second, soils are mostly permeable which would allow for drainage into the soil if it has been scarified and vegetated after construction.

If the proposed site is cleared at the latest possible time and some portions are revegetated as soon as possible after construction, sedimentation and erosion should be mimimal even though erodible soils are present.

5. Impact On Aquatic Ecology

Several effects of power plant construction on aquatic systems can occur. These can be fitted into the general categories of habitat modification and habitat loss. In the case of George Neal Unit 4, no aquatic habitat will be lost as a result of construction.

Habitat modifications result primarily from changes in chemical water characteristics. Of these, increases in total suspended solids (TSS) due to site dewatering, runoff, and in-water construction of the intake and discharge structure usually has the greatest potential for impact, However, TSS concentrations in the Missouri River were greater than 50 mg/l (Table III-C-3) in every month except December, January and March. Assuming all discharges and runoff are treated to reduce TSS to 50 mg/l as required by federal regulations, no impact should result except possibly during the winter months.

McKee and Wolf[10], report that fish generally tolerate TSS at concentrations of 20,000 mg/l and higher. However, several centrarchid species are sensitive to concentrations of 75-100 mg/l during spawning periods. Because treated discharges from the construction area will contain lower concentrations of TSS; spawning of sensitive species in the Missouri River occurs during late spring; and centrachids will not spawn directly in the Missouri River, but in quiet backwaters or flooded areas; no impact due to raised TSS levels during the winter months is expected.

Higher TSS levels in the Missouri River due to the in-water construction of the intake and discharge structure will occur only at the time of cofferdam placement and removal. Although TSS levels at these times could exceed critical values for spawning of some centrachids, the increased levels will occur for only brief periods of time and are not expected to persist in backwater areas where spawning occurs.

Other potential changes in chemical water characteristics could result from spillage of corrosion inhibitors, oil, etc. Care will be exercised in the storage and use of these materials, and any spillage is immediately reported and properly dealt with.

One small backwater located immediately behind the Iowa riprap, Site A in Exhibit III-C-12 may be disturbed by construction. This backwater is a potential source of recruitment for Missouri River fish populations given a free connection with the river in summer and fall. However, it often serves as a sink, wherein spawned individuals are lost due to receding water levels, high temperatures and low oxygen concentrations.

6. Air Quality

During construction, care will be taken to minimize significant adverse effects on air quality. The project will comply with the provisions of the Iowa Air Pollution Control Commission "Rules and Regulations Relating to Air Pollution Control" which are applicable during construction activities.

All construction waste material will be disposed of either by hauling to landfill sites, or by on-site burning as provided under the Iowa State Regulations. Waste from landscape clearing may be burned as permitted under the State of Iowa Air Commission's Rules and Regulations Subsection Number 4.2 (455B), Openburning, with the following restrictions: 'However, burning of landscape waste produced in clearing, grubbing, and construction operations shall be limited to areas located at least one-fourth mile from any inhabited building. Rubber tires shall not be used to ignite landscape waste."

Construction techniques at Neal Unit 4 will follow the guidelines set forth in Subsection Number 4.3(2)c, Fugitive Dust, of the State of Iowa Air Pollution Control Commission's Rules and Regulations. During dry periods all access roads will be watered or treated with calcium chloride to suppress fugitive dust. In addition, all cleared storage areas which may create a dust problem will be paved or rocklined.

The effects of airborne fugitive dusts will be minimal due to the above outlined steps and the location of the plant in an industrial park area away from residential areas.

Construction equipment and practices will be in compliance with Iowa Department of Environmental Quality, Air Quality Commission Rules and Regulations Relating to Air Pollution Control, Sections 4.3(d)(2) Gasoline-powered vehicles and 4.3(d)(3) Diesel-powered vehicles. Gasoline vehicles are prohibited from emitting visible emissions for longer than five seconds. Diesels are prohibited from emitting smoke equal to or darker than 40 percent opacity for longer than five seconds.

It is anticipated that most construction workers will use Interstate 29 for travel to and from the plant site. This traffic can be expected to result in an increase in concentrations of hydrocarbons, carbon monoxide, nitrogen oxide, photochemical oxidants and particulate matter in the vicinity of the highway.

B. CIRCULATING WATER SYSTEM

1. Intake System

The cooling water for Neal Unit 4 will be withdrawn from a reinforced concrete intake structure located on the east bank of the Missouri River. During normal plant operation, about 317,400 gpm (707 cfs) of cooling water will be passed through the condenser and then discharged directly back to the river through a seal well located downstream from the intake structure. This comprises approximately 2 to 5 percent of the monthly average river flow that passes the site. Combined with condenser flow through Neal Units 1-3, this could represent a total circulating water system passage of about 11 percent of the river flow in December, January, February; 8 percent in March; and 5 percent the rest of the year. The velocity through the traveling screens will be about 0.9 feet per second (fps) with an approach velocity of about 0.4 fps at the design mean water elevation of 1055 feet (river flow = 12,000 cfs). At mean high water, (el 1067 feet river flow = 50,000 cfs), the velocity through the traveling screens will be about 0.7 fps with an approach velocity of 0.3 fps. A more detailed discussion of the intake system is found in Section II-B-2.

a. Effects on Aquatic Ecology

Power plant intake operation can effect the ecology of a water body by entraining and impinging aquatic organisms. These potential impacts are treated in detail in the following sections. The bases for assessments given here are acute temperature mortality data; time-temperature exposure data where available; empirical data on condenser passage mortalities at other steam electric stations; life history and behavioral information; and actual operating data for Neal Units 1, 2, and 3 regarding impingement rates and mortalities, and entrainment rates.

i. Condenser Entrainment

Entrainment is the process whereby aquatic organisms are carried through a power plant circulating water system. Only those organisms that are not filtered by the traveling screens (mesh size = .95 cm) are entrained. Because organisms this small are relatively non-motile when compared to water velocities at the intake, it is assumed individuals cannot avoid entrainment. If entrainment is non-selective and if the distribution of organisms in the water body is homogeneous, the relative number of entrained organisms is equal to the relative amount of the river flow withdrawn.

Homogeneity of organism distribution has been experimentally tested at Port Neal. Appendix Table A-IV-B-1 includes the results of this study. The river was divided at two stations (Transects 1 and 6, Exhibit III-C-3) into Iowa, mid-river, and Nebraska sections. Triplicate phytoplankton samples were taken at random within each section, and counts of organisms present in a single strip across each of three Sedgewick - Rafter cells were made. This subsampling experiment is illustrated in Exhibit IV-B-1.

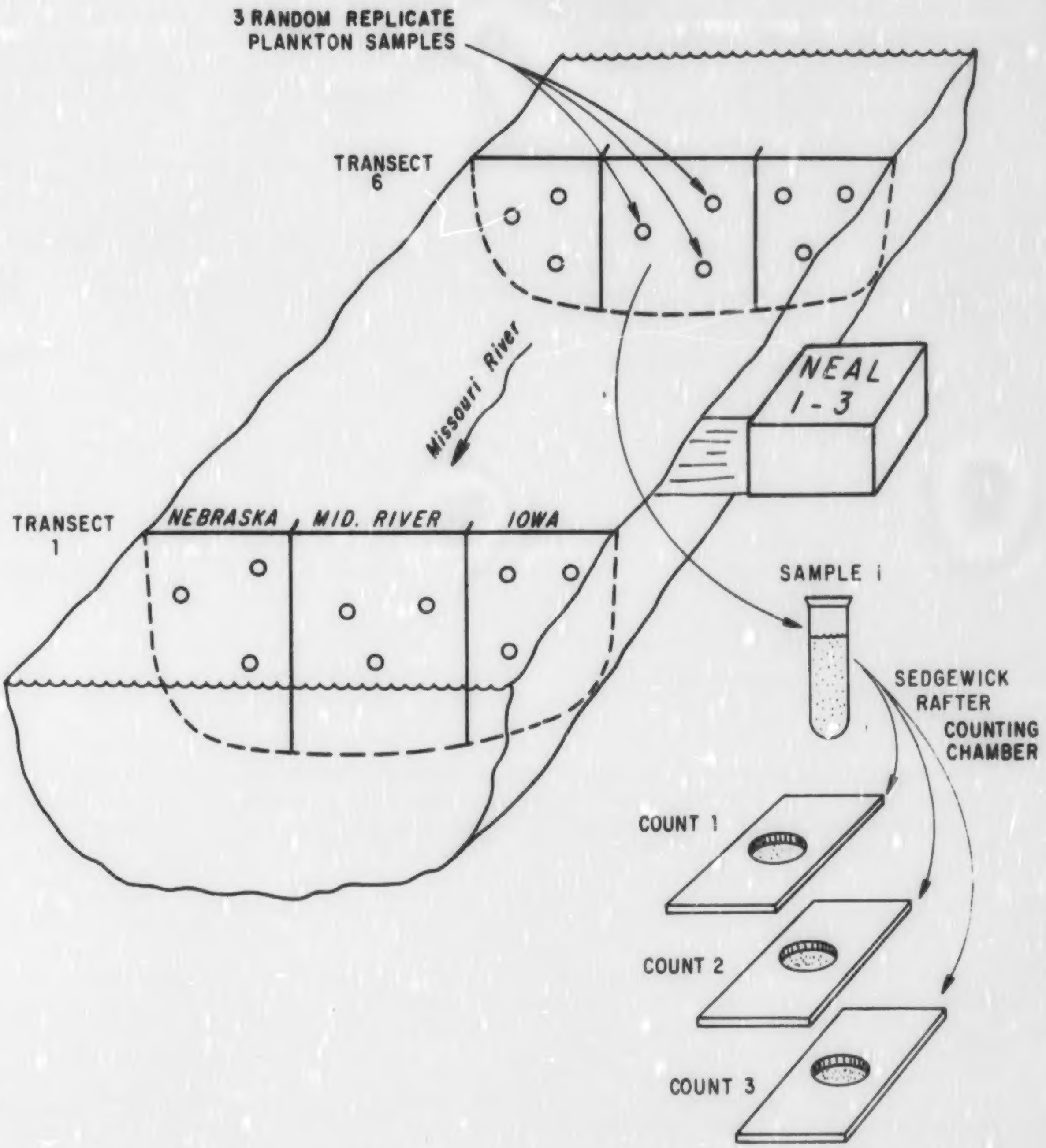
Distribution and abundance of green algae were highly variable. This could have been due to current vectors and velocities but the lack of diatom variation among stations suggests that this is not the case. Analysis of variance of the results using transformed counts of total green algae indicated that significant differences occurred even at the replicate - within stratum level (Table IV-B-1). This suggests that the variability could be due to inadequate sample size, an insufficient number of replicates, and/or some other aspect of the sampling design.

By dividing the circulating water system flow rate for Neal Unit 4 by Missouri River flow rates, it can be seen that between 1 and 8 percent of the entrainable organisms present in the river will be entrained (see Table IV-B-2). Under average flow conditions between 2 and 5 percent of the organisms will be entrained. During the spring and summer months, when greatest numbers of fish eggs and fry, zooplankton, drift and phytoplankton were observed, only 1-2 percent of the flow will be withdrawn.

While passing through a circulating water system, entrained organisms are subjected to pressure changes, temperature changes, changes in water chemistry and mechanical damage. Effects of these stresses are dependent upon the type of organism, the maximum stress encountered, and the duration of the stress.

Phytoplankton

The effects of entrainment on phytoplankton appear to be primarily a result of exposure to increased water temperature[1]. Increased temperatures can either increase or decrease productivity depending upon the intitial water temperature and the amount of temperature increase[1,2,3]. Most algae prefer temperatures between 20-25°C although a few prefer lower temperatures and many, especially the blue green species, prefer higher temperature[4,5,6]. Maximum temperature tolerances of greater than 30°C have been reported for Nitzchia, Chlorella, Oscillatoria, Lyngbya, and Ankistrodesmus[7]. Although the test species were not necessarily the same as those found in the Missouri River, it is generally reported that diatoms, the


3 RANDOM REPLICATE
PLANKTON SAMPLES
TRANSECT
6
Missouri River
NEAL
1 - 3
TRANSECT
1
NEBRASKA
MID. RIVER
IOWA
SAMPLE i
SEDGEWICK
RAFTER
COUNTING
CHAMBER
COUNT 1
COUNT 2
COUNT 3

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

SCHEMATIC OF PLANKTON SUBSAMPLING
EXPERIMENT, MAY 30, 1974

DATE: SCALE:

EXHIBIT
IV-B-1

Level	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio
3 (Stations)[1]	19.592	1	19.5915	10.8564**
2 (Strata: Stations)[2]	31.459	4	7.0647	4.3582*
1 (Replicates: Strata)	21.655	12	1.8046	2.4085*
0 (Slides: Replicates)	26.973	36	0.7492	

* Significant at the .05 level of probability.

** Significant at the .01 level of probability.

1-Station 1 vs. Station 6 (Exhibit III-C-3).

2-Iowa, Mid-River, Nebraska (Exhibit IV-B-1).

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

ANALYSIS OF VARIANCE ON TRANSFORMED COUNTS ($\sqrt{x + ½}$) OF TOTAL GREEN ALGAE ENUMERATED IN THE SPECIAL PLANKTON DIST. STUDY, MAY 30, 1974

DATE: SCALE:

TABLE
IV-B-1

Month	Maximum Flow (gpm x 10^3)	Percent of Max Flow Withdrawn By Neal 4	Average Flow (gpm x 10^3)	Percent of Average Flow Withdrawn By Neal 4	90 Percent Low Flow (gpm x 10^3)	Percent of Low Flow Withdrawn By Neal 4
Jan	10.350	3	6.975	5	3.825	8
Feb	27.000	1	7.200	4	4.050	8
Mar	18.810	2	10.350	3	4.500	7
Apr	34.380	1	15.300	2	12.510	2.5
May	23.040	1	15.300	2	13.050	2
Jun	31.410	1	16.200	2	13.050	2
Jul	24.345	1	16.650	2	13.612.5	2
Aug	26.325	1	18.000	2	14.085	2
Sept	25,425	1	17.325	2	14.085	2
Oct	23.760	1	15.300	2	13.612.5	2
Nov	25.065	1	15.750	2	12.150	3
Dec	21,690	1	7.425	4	4.500	7

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

NEAL UNIT 4 DESIGN CWS FLOW (317,400 GPM) AS A FUNCTION OF MONTHLY MISSOURI RIVER FLOWS DURING THE PERIOD 1965-1972

DATE:
SCALE:

TABLE
IV-B-2

dominant phytoplankton in the Missouri River, tolerate temperatures near or slightly above 30°C[8].

On the basis of the preceding, it appears likely that phytoplankton entrainment will result in primary productivity increases during winter months, and decreases during summer months. However, Morgan and Stross[1] suggest that the pressure, chemical and mechanical stresses of entrainment may lessen any productivity stimulation. Because no biocides will be used in Neal Unit 4, these additional negative effects may be negligible.

In any case, changes in phytoplankton productivity are not likely to have any significant ecosystem effects. The river water is so turbid that autochthonous production is likely restricted to the limited aufwuchs community found on the shallow portions of river control structures and other solid substrates. When compared to allochthonous sources of carbon, autochthonous production probably contributes little to the total carbon budget.

Zooplankton

The zooplankton species subject to entrainment were described in Section III-C-2. Data obtained in summer, 1973, and in spring and summer, 1974 on passage of organisms through the existing Neal Units 1 and 2 condensers are included in Appendix Tables A-IV-B-2 and 3. These data were collected by suspending nets in the intake forebay of Neal 1 and 2 between the traveling screens and the trash racks and provide a good baseline for evaluating Neal 4. The discrepencies between the two sets of data arose from a smaller mesh net being used in 1974, resulting in higher and more representative number of Daphnia than in 1973.

Together, the studies convey a realistic picture of large zooplankton entrainment at Neal Units 1 and 2. Small zooplankton species, especially rotifers, immature cladocerans, and immature copepods, were not effectively sampled by the large mesh nets that were generally employed. However, large individuals are most important as prey for fish[9,10], including freshwater drum[11,12], channel catfish fry[13], gizzard shad[14], and bigmouth buffalo[12].

Mortality of zooplankton resulting from entrainment is not likely to have a significant ecosystem impact. Hynes[15] notes that turbid rivers carry few true plankton and the Cladocera (other than Bosminidae) are especially susceptible to silt. The large numbers of Daphnia found in the Missouri River indicates much of the zooplankton production is occurring in backwater areas and upstream reservoirs, and many of the individuals sampled are strays from these areas. As these individuals are not contributing to the secondary productivity of the system and as their biomass remains available to other trophic levels after entrainment, few effects of these mortalities are expected.

Undoubtedly, some zooplankton, especially rotifers, are viable producing populations. Rotifers, however, are more resistant to high temperatures so their entrainment mortality should be low. Because members of this phyla also have rapid regeneration times[16] and because only a small portion of the standing crop will be entrained, little impact should result from entrainment of viable members of this zooplankton community.

The smaller members of the drifting benthos are also subject to entrainment. Drift samples taken as part of the baseline survey (see Appendix Table A-III-C-2) provide an indication of the constant (ie, daytime) drift[17]. Research[18] has shown that the greatest numbers of drifting organisms occur at night, often in a sharply peaked, bi-modal pattern. Because of this behavioral drift the sampling data could underestimate numbers entrained.

A more accurate estimate of entrained macroinvertebrates is provided by operating data from Units 1 and 2. Sheet 2 of Appendix Table A-IV-B-2 presents the numbers of organisms entrained over a 24 hour period. The remainder of Appendix Tables A-IV-B-2 and A-IV-B-3 presents data for macroinvertebrates comparable to those previously described for zooplankton entrained in 1973 and 1974.

Although little work has been done on temperature tolerances of larval macroinvertebrates, one study[19] indicated that the median tolerance limit (TLM) of mayflies, stoneflies, and caddis flies was in the range 20°C (68°F) -30°C (86°F). Ephemerella subvaria and Stenonema tripunctatum, both mayflies, had TLM's of 21.5°C (70.7°F) and 25.5°C (77.9°F), respectively. Brachycentrus americanus, a caddis fly of the family Brachycentridae, had a 96 hr TLM of 29°C (84.2°F) Dipterans of the family Tendipedidae (midges) have been found to exhibit upper lethal temperature tolerances of between 29°C (84.2°F) and 35°C (95°F)[20,21,22], and thus may be less affected by heat than the other orders of insects. Mihursky and Kennedy[22] cited data indicating that some genera showed upper limits as high as 37.8°C (100°F) and 39.4°C (103°F). Temperatures achieved inside the Neal Unit 4 condensers will be in excess of 32.2°C (90°F) in summer.

Benthic macroinvertebrates are important to lotic ecosystems because of their role in processing organic material and as a food item for fish[15,18,23,24,25]. In the Missouri River in the vicinity of the George Neal site, channelization has resulted in a habitat generally unsuited to benthic invertebrate production. For this reason, the importance of benthic invertebrates to the ecosystem in this region is suspect. When compared to planktonic invertebrates, the benthic populations are more susceptible to damage resulting from low level continuous mortality because of their much greater regeneration times. However, in the case of entrainment, only that portion of the benthic community comprising the drift is subject to this mortality. Waters[23] reports that drift invertebrates usually comprise .01 to .5 percent of the total benthic community at any one time.

Entraining 2 to 5 percent of these should result in little impact.

Fish

Effects of power plant entrainment on fish eggs and larvae were reviewed recently by Marcy[26]. He noted that, while most studies have dealt with the effects of increasing temperatures, some of the more recent work has indicated that many of the observed mortalities may be due to mechanical stress. Marcy[27] reported that 80 percent of the mortality experienced by young white perch, carp, white catfish, American eel, spottail shiner, and johnny darter, could be attributed to mechanical abrasion. Schubel[28] found that time-temperature exposure histories experienced by fish eggs of a number of estuarine species did not preclude successful hatching. Heat is responsible for some inner plant mortality, however, and in fact Coutant[29] has developed predictive equations for time-temperature moralities of a number of young fish, including gizzard shad and channel catfish. Davies and Jensen[30] (In: Marcy[26]) indicated that rapid mixing of circulating water discharge helps minimize heat mortality, but due to the combination of effects it is probably not unreasonable to assume 100 percent mortality of entrained fish eggs and larvae at Neal 4.

The majority of species inhabiting the river provided no parental care of the eggs, and produced large numbers of eggs, and in many cases demersal or demersal/adhesive ones. Numbers of fish eggs and larvae at Port Neal are highest in May, June, July, which is consistent with the life histories of the warm water fish present in the river. Total numbers found in 1973, 1974 (Appendix Tables A-IV-B-2 and 3), and 1975 represented only a few species (Table IV-B-3), including unidentified minnows, freshwater drum, and sauger. Sauger were not abundant, the minnows and drum comprised 20 percent and 79 percent, respectively, of all larvae found in the 1974 samples. In the 1975 samples, minnows comprised 57 percent and drum made up 42 percent of all larvae found. Based on the median number of eggs and larvae found in samples collected for entrainment on May 23, May 31, June 22, and July 3, and July 19, 1973 (ie, 22.5 organisms), a gross estimate of 5500 eggs and larvae per day may be given for the combined action of Neal 1-4 during the productive season. About half that total would be due to Neal Unit 4 alone. These are extremely crude estimates and recent data provided by Hey and Baldwin[31] indicate that at times the numbers may be much higher. Estimates based on 1974 data were as high as 500,000 larvae per day for Neal Unit 4. These are point estimates, (see Table IV-B-4) and additional data are necessary to produce more precise and representative projections. However, the 500,000 larvae per day is similar to that reported at Omaha Public Power District's Ft. Calhoun Station. During their May 7 to July 24, 1974 survey, they reported a mean larval density of 31.56 per 100 m^3. Projecting this density to Neal Unit 4, which will have an intake volume of about 20 m^3/sec., amounts to

Month	Species	Condenser Passage	Drift Net	Total
May	Notropis spp (minnows)	42	110	152
	Sauger	4	0	4
	Unidentified	0	1	1
				157
June	Notropis spp.	108	33	141
	Freshwater drum	826	62	888
	Uuidentified	6	0	6
				1035
July	Notropis spp.	101	51	152
	Freshwater drum	132	2	134
	Unidentified	1	0	1
				287
August	Nortropis spp.	3	1	4
	Freshwater drum	4	0	4
				8

Source: Hey and Baldwin[31]/

Collection made at weekly intervals

Drift Net Data represent a composite of three, 5 minute drift net samples (243 u)

Condenser Passage
Data represent a composite of 4 thirty minute samples for each date

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

COMPOSITION OF FISH LARVAE FOUND IN DRIFT NET AND CONDENSER PASSAGE (ENTRAINMENT) SAMPLES FROM MAY-AUGUST 1974
SHEET 1 OF 2

DATE: SCALE:

TABLE
IV-B-3

Month	Species	Condenser Passage	Drift Net	Total
May	Notropis	1	18	19
	Unidentified	0	1	1
				20
June	Drum	125	202	327
	Notropis	74	272	346
	Bigmouth buffalo buffalo		2	2
	Goldeye		1	1
	Unidentified		1	1
				677
July	Drum	58	31	89
	Notropis	74	131	205
	Bigmouth buffalo		1	1
	Catastomus		1	1
	Blue sucker	1		1
	Centrarchidae		1	1
	Ictiluridae	1		1
	Unidentified		1	1
				300
August	Notropis	2	2	4
				4

Collection made once a week in May and August and twice a week in June and July

Time was the amount required to sample 4,300 gallons of water

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

COMPOSITION OF FISH LARVAE FOUND IN DRIFT NET AND CONDENSER PASSAGE (ENTRAINMENT) SAMPLES FROM MAY-AUGUST 1975
SHEET 2 OF 2

DATE: SCALE:

TABLE
IV-B-3
(Cont.)

Month	Species	Number Sampled	Volume Sampled (gal)	Estimated Number Entrained (per Day)	
				Unit 4	Units 1-4
May	Notropis	1	17,200	26,573	67,751
June	Drum	125	34,400	1,660,815	4,234,450
	Notropis	74	34,400	983,202	2,506,793
July	Drum	58	43,000	616,494	1,571,826
	Notropis	74	43,000	786,561	2,005,432
	Blue Sucker	1	43,000	10,629	2,725
	Ictaluridae	1	43,000	10,629	2,725
August	Notropis	2	8,600	106,292	271,004

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* Based on 1975 condenser passage data;317,400 gpm intake flow for Unit 4; 491,850 gpm intake flow for Units 1-3.

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

POINT ESTIMATES OF FISH EGG AND LARVAE ENTRAINMENT*
NEAL UNITS 1-4 AND 4

DATE:

SCALE:

TABLE
IV-B-4

545,356 larval fish per day. Walleye and sauger were a significant part of the entrainment loss at Ft. Calhoun. Table IV-B-5 is offered so the reader may parallel these first approximations with fecundities reported in the literature for Missouri River species. Some concern can be expressed regarding mortality of freshwater drum, walleye and sauger; it is impossible to state unequivocably what effect entrainment will have on populations of these species in the river.

ii. Impingement

Impingement problems arise at cooling water intake structures for a variety of reasons. These problems are dependent upon location, physical design, intake water velocities, screen rotation, spray wash velocities, and method for disposal of impinged fish. The Environmental Protection Agency issued a development document on proposed best technology available for minimizing adverse effects of circulating water system intakes.[32] At Neal Unit 4, each of the above parameters as well as the EPA developed information and results from the biological studies described previously have been considered, and the resultant design should produce minimal fish mortalities.

Impingement at Neal Units 1 and 2 was monitored from February 1974 through February 1975. Data from these studies are given in Appendix Table A-IV-B-4. They represent all time periods within each week, and a variety of operating conditions (ie, number of pumps and screens working). Samples were taken from three of four intake bays for 16 hours per week from February through May 1974, and for 20 hours per week from June 1974 through February 1976. The following trends were observed in these data: impingement rates exhibit seasonal trends; impingement mortalities are depended upon the species of fish impinged; and number of fish impinged exhibit a diurnal periodicity. These trends are more readily observed in Table IV-B-6.

Seasonal patterns of impingement result from a combination of several factors. Small, weakly swimming fish are more susceptible to impingement than larger fish. In fact, 95 percent of the fish in impingement samples taken at Neal Units 1 and 2 were less than 15 cm long. Small fish are more abundant in late summer when young - of - the - year fish grow large enough to be impinged. Warmed water, recirculated for intake deicing during the winter, may attract fish to the intake and increase impingement during that season. Catfish, in particular, may be attracted to the structure due to increased temperature and the shelter afforded them. Brown et al[33] showed that channel catfish sought shelter day and night when temperatures dropped below 4°C (39.2°F). Fish also exhibit decreased swimming ability at lower temperatures. This has been cited as a factor in increased impingement rates of winter flounder at Brayton Point, Massachusetts[34]. Hocutt[35] examined the relationship between channel catfish swimming performance between 30°C/no change and 30°C/15 drop. Swimming speeds of catfish, 14 to 15.4 cm long, subjected to a 15°C (59°F)

Species	Number of Eggs Per Female
Carp (Cyprinus carpio)	30,000 to 1.400.000; most authors reporting about 1/2 million
Goldeye (Hiodon alosoides).	5.800 to 25.200 average 14.150
Gizzard shad (Dorsoma cepedianum)	22.405 to 5.439.12 average 300.000
Carpsucker (Carpiodes carpio)	4.828 to 149.744 average 102.766
Bigmouth buffalo (Ictiobus cyprinellus)	Average 400.000
Channel catfish (Ictalurus nebulosus)	200 to 70.000
Walleye (Stizostedion vitreum vitreum)	50.000 to 400.000
Freshwater drum (Aplodinotus grunniens)	200.000 to 400.000

Sources: Carlander[58]/ Breder and Rosen[59]/ Lopinot[60]/

envirosphere company A DIVISION OF EBASCO SERVICES INCORPORATED	IOWA PUBLIC SERVICE Co. - NEAL UNIT 4 FECUNDITIES OF SELECTED SPECIES OF MISSOURI RIVER FISH DATE: SCALE:	TABLE IV-B-5

Mortality Rates, Total Mortality and Percent Abundance of the Most Commonly Impinged Fish Species

Species	Percent Mortality Rate for each Species	Percent Total Mortality of all Impinged Fish	Percent Total Abundance of all Impinged Fish
Gizzard shad	67.7	54.8	36.7
Freshwater drum	37.2	21.3	25.2
Channel catfish	13.7	2.0	6.3
Bluegill	9.8	1.1	6.3
Carpsuckers	33.3	3.9	5.2

A Comparison of Collecting Times and Total Fish Sampled per Interval

Hours*	Number of Fish Collected
9:00 a m - 1:00 p m	100
1:00 p m - 5:00 p m	84
5:00 p m - 9:00 p m	112
9:00 p m - 1:00 a m	145
1:00 a m - 5:00 a m	179
5:00 a m - 9:00 a m	147

*data represents compilation of all 24 hour per week studies from June 1974 through February 1975.

Hours**	Number of Fish Collected
8:00 a m - 12:00 p m	6
1:00 p m - 5:00 p m	11
7:00 p m - 11:00 p m	15
1:00 a m - 5:00 a m	8

**data represents compilation of all 16 hour per week studies from February 1974 through June 1974.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

IMPINGEMENT DATA TRENDS NEAL UNITS 1 & 2
1974-1975

DATE: SCALE:

TABLE
IV-B-6

temperature drop were above 1.38 fps. King[36] found that channel catfish under 10.0 cm swam at a maximum rate of 1.1 fps. Thus, in winter, catfish coming in contact with the traveling screens at Units 1-3 might not be able to escape. In the case of Neal Units 1 and 2 (Appendix Table A-IV-B-4), all impinged catfish were observed between the months of September and April. Seasonal changes in river water levels also serve to cause impingement variations. As noted previously, approach velocities and velocities through the traveling screens are dependent upon water levels. Finally, plant operations serve to cause seasonal changes in impingement. For example, on many of the winter sampling dates, only one of the two circulating water system pumps was in operation.

Among the five most commonly impinged fish species, the mortality rate ranges from 9.8 percent for bluegill to 67.7 percent for gizzard shad (see Appendix Table A-IV-B-4). This is undoubtedly due to species specific variations in response to the factors mentioned previously.

Diurnal variations in impingement rates are best demonstrated in the data collected from June 1974, to February 1975. During this period of time, 471 fish were impinged between 9:00 pm and 9:00 am, while only 296 were impinged in the 9:00 am to 9:00 pm sampling periods. A similar trend can be seen in the data collected between February and June 1974, with 23 fish impinged during the 7:00 pm to 11:00 pm, and 1:00 am to 5:00 am sampling periods, while only 17 fish were impinged during the 8:00 am to 12:00 and 1:00 pm to 5:00 pm sampling periods. When considered on a monthly basis and subjected to statistical analyses using the Wilcoxon matched pairs signed ranks test[37] the combined data were found to exhibit day/night differences significant at the $\alpha = .05$ level.

Impingement samples have been collected at Neal Unit 3 since January 11, 1976, and the resultant data have become available[38]. These are summarized in Table IV-B-7. The procedure used to obtain these data is similar to that used at Units 1 and 2 except that washing from all four intake screens were sampled.

The most obvious characteristic of Unit 3 intake operation is that substantially higher numbers of fish were impinged there than at the Unit 1 and 2 intake during similar months of the year. Simultaneous monitoring at Units 1 and 2 and at Unit 3 from February 22-28, 1976 (Table IV-B-8) suggests this is not due to an annual variation in the number of fish in that part of the Missouri River. Discussions with J Hey and K Baldwin suggested two possible explanations for the higher Unit 3 impingement. First, greater amounts of heated discharge water are recirculated at the Unit 3 intake than at the Units 1 and 2 intake. This could result in greater fish attraction to the intake area and hence higher impingement rates. Second, approach velocities as high as 5 feet per second have been measured at the Unit 3 trash racks. This could have resulted from clogging of the racks or

	Time of Day						Length		Condition	
	5 a m - 9 a m	9 a m - 1 p m	1 p m - 5 p m	5 p m - 9 p m	9 p m - 1 a m	1 a m - 5 a m	Less than 15 cm	Greater than 15 cm	Alive	Dead
Blue sucker			1		2	1		4	4	
Carp			1	1	2	1	3	2	3	2
Carpsucker	1	2	5	6	2	5	19	1	12	8
Channel catfish	19	45	77	97	59	57	350	4	321	33
Drum		5	14	5	7	4	28	7	18	17
Flathead catfish	1		2	5	4	3	14	1	11	4
Goldeye				1				1		1
Green sunfish				2		2	4		2	2
Mirror carp			1					1	1	
Notropis					2	3	5		2	3
Perch	1						1		1	
Sauger		2	2	3			6	1	7	
Shorthead redhorse						1	1		1	
Smallmouth buffalo	1		4	2			6	1	6	1
Walleye	3			1			2	2	4	
White bass	1	1	4		3	1	8	2	9	1
White sucker					1		1		1	
Yellow perch		3		4	2	3	12		9	3
Total	27	58	111	127	84	81	460	27	412	75
Crayfish	1		5			1	7		5	
Frog				1					1	

Note: Collection effort = 68 hr

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

IMPINGEMENT DATA. NEAL UNIT 3
JANUARY 1976
(Sheet 1 of 3)

DATE: SCALE:

TABLE
IV-B-7

	Time of Day						Length		Condition	
	5 a m - 9 a m	9 a m - 1 p m	1 p m - 5 p m	5 p m - 9 p m	9 p m - 1 a m	1 a m - 5 a m	Less than 15 cm	Greater than 15 cm	Alive	Dead
Bigmouth buffalo				1				1	1	
Black bullhead		1			1	1	2	1	3	
Black crappie			1				1			1
Blue sucker			1		1			2	2	
Carp					1		1		1	
Carpsucker	2	2	1	1	5		11		3	8
Channel catfish	8	16	15	5	12	6	58	4	53	9
Drum	19	20	10	18	18	3	85	3	44	44
Flathead catfish	1	1	5	4	1	1	13		12	1
Gizzard shad	1		1		1		1	2	1	2
Green sunfish			1	4			5		2	3
Notropis				1			1	1	1	
Orange-spotted sunfish		1	1		1		3		2	1
Perch	1		1		5	2	9		9	
Sauger			1	1			1	1	2	
Shorthead Redhorse					1			1	1	
Smallmouth buffalo			2	1	1	2	6		3	3
White bass					4	2	6		5	1
White crappie		1		1			2			2
Yellow perch		1	1				2		2	
Total	42	43	41	37	52	17	207	16	147	75
Crayfish	2				1		3		3	

Note: Collection effort = 108 hr

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

IMPINGEMENT DATA, NEAL UNIT 3
FEBRUARY 1976
(Sheet 2 of 3)

DATE:
SCALE:

TABLE
IV-B-7
(Cont'd)

	Time of Day						Length		Condition	
	5 a m - 9 a m	9 a m - 1 p m	1 p m - 5 p m	5 p m - 9 p m	9 p m - 1 a m	1 a m - 5 a m	Less than 15 cm	Greater than 15 cm	Alive	Dead
Bigmouth buffalo	1							1	1	
Black bullhead			1	1			2		2	
Bluegill		1					1			1
Carp	1	3		2	1	3	5	5	9	1
Carpsucker	1	1		9	3	1	14	1	9	6
Channel catfish	13	42	5	6	16	2	72	12	78	6
Drum	101	127	1	47	18	11	246	59	233	72
Flathead catfish	1				3		4		4	
Gizzard shad				1				1	1	
Goldeye		3						3		3
Notropis			3		1		4		2	2
Perch	5	1	1	1	3	3	13	1	13	1
Sauger		1			1	1	2	1	3	
Smallmouth buffalo	10	20		1	9	1	38	3	33	8
Walleye				3	1	4	6	2	8	
White bass	1	1			4	1	7		5	2
White sucker		1					1			1
Total	134	201	11	71	60	27	415	89	401	103
Crayfish					4		4		3	1

Note: Collection effort = 86 hr

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

IMPINGEMENT DATA, NEAL UNIT 3
MARCH 1976
(Sheet 3 of 3)

DATE: SCALE:

TABLE
IV-B-7
(Cont'd)

Neal Units 1 & 2

	Alive	Dead	Total
Channel catfish	1		1
Drum	2	1	3
Total	3	1	4

Collection effort = 24 hr

Neal Unit 3

	Alive	Dead	Total
Black bullhead	2		2
Blue sucker	1		1
Carp	1		1
Carpsucker	1	1	2
Channel catfish	6	2	8
Drum	12	20	32
Flathead catfish	4		4
Gizzard shad	1		1
Perch	9		9
Sauger	1		1
Shorthead redhorse			
Smallmouth buffalo	1	1	2
White bass	3		3
Total	42	24	66

Collection effort = 24 hr

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

IMPINGEMENT DATA, NEAL UNITS 1, 2 AND 3
FEBRUARY 22-28, 1976

TABLE
IV-B-8

DATE: SCALE:

screens with debris or ice, stop logging an intake bay, etc. It is not known whether these velocities persist on a day to day basis or were peculiar to the sampling date. However, if such high velocities have characterized the operation of the Unit 3 intake, it would account for the observed impingement rates.

It should be noted that the mortality of impinged fish during the three month period is substantially lower at Unit 3 (21 percent of impinged fish) than at Units 1 and 2 (36 percent of impinged fish). This observation is not consistent with the persistent high velocity hypothesis. Latent mortalities (mortalities occurring after removal from the screens) are also probably high at Units 1, 2 and 3, as only a high pressure screen wash is used and additionally in the case of Units 1 and 2, because fish are returned to the river in the heated discharge zone.

It is difficult to predict Unit 4 impingement effects on the basis of the disparate data resulting from Units 1 and 2, and Unit 3 operations. However, it appears likely that Unit 4 impingement rates will be lower than those at Units 1 and 2.

This prediction is based on two factors: the lack of operating experience at Unit 3, and the superior Unit 4 intake design.

Operation of Unit 3 commenced in December 1975, approximately one month before the impingement monitoring program was begun. As operating experience is gained, it should be possible to optimize recirculated deicing water flow so that the intake can be kept ice free with a minimum of fish attraction to that area. Operating experience should also help to prevent the extremely high velocities such as was observed on April 19, 1976.

Intake designs for the four Neal Units have been previously described in Chapter II. Several design features of the Unit 4 intake should help to reduce both impingement rates and the rate of mortality resulting from immediate and latent impingement.

The design low water level (DLWL) velocity (maximum velocities) through traveling screens at Neal Units 1, 2, and 3 is 2.25 fps. This is typical of most existing once-through circulating cooling water systems (EPA[32]). The approach velocity to the screens is 1.12 fps. These maximum velocities occur in winter when water levels are lowest. During the rest of the year, the velocity through the screens is less than or equal to 1.0 fps, and screen approach velocity is less than .8 fps.

The DLWL velocity through the screens at Neal Unit 4 is 0.9 fps, with the approach velocity equal to 0.4 fps. Velocities in navigation season will be significantly lower (0.3 fps on approach). Thus, the design specifications for intake velocities at Neal Unit 4 are lower than those of Neal Units 1, 2, and 3 and impingement rates, therefore, should be lower at Neal Unit 4.

At Neal Unit 4, fish mortalities will be reduced further by use of "fish buckets" on the vertical traveling screens and sluicing the removed fish back to the Missouri River, upstream of the discharge plume but at a point where they are not likely to be re-impinged. A sequential low and high pressure screen wash system will be employed (Exhibit II-B-4) in order to remove fish more gently from the traveling screens, and a vertical sand weir will be used in an effort to reduce crayfish entrapment.

In view of present impingement rates at Neal Units 1 and 2, considering the design modification established to date, and assuming plant operations to minimize impingement, ecological effects of Neal Unit 4 impingement should be slight. Although it will be impossible to separate the impingement mortality impacts of Neal Units 1-4 from effects of habitat reduction, careful monitoring should establish at least the direct mortalities of fish actually impinged.

b. Effect on Other Water Uses

The intake system for Neal Unit 4 will have little impact on other Missouri River water uses. The Missouri River is primarily used for navigation and irrigation in the vicinity of the proposed plant site. In addition, however, the river is a primary source of water for local industry, and is also used for recreational purposes by the local population.

A total of about 317,400 gpm of flow will be withdrawn from the river and utilized for condenser cooling water by Neal Unit 4. The flow will be discharged directly back to the river at a point located immediately downstream of the intake. The proposed intake system will induce minimal consumptive water loss on the river (approximately 20 acre feet per year) and therefore will have little effect on the supply of river water available for irrigation, recreation and municipal or industrial water supply.

During the navigation season, the plant intake water demand will represent only about 2 percent of the total river flow, In addition, the intake structure will be constructed on the bank of the river and will not intrude into the river navigation channel. Consequently, the proposed intake system should have no distinguishable impact on river navigation.

2. Discharge System

a. Effects on Missouri River Temperature Distribution

This section presents the results of the thermal analysis performed for the proposed Neal Unit 4 condenser cooling water system (Reference III-B-4) along with a discussion of the applicable State and Federal thermal discharge criteria.

i. State Thermal Discharge Criteria

The information presented in this section has been obtained from the Water Quality Standards adopted by the State of Iowa on February 12, 1974.

- Mixing Zone

  The Iowa standard applies outside of an allowable mixing zone. With regard to the mixing zone, the Iowa standard indicates that:

  "The mixing zone shall contain not more than twenty-five (25) percent of the cross-sectional area or volume of flow in the receiving body of water."

- Thermal Discharge Criteria

  Iowa thermal discharge criteria state that:

  "No heat shall be added to the Missouri River that would cause an increase of more than 5 degrees Fahrenheit. The rate of temperature change shall not exceed 2 degrees Fahrenheit per hour. In no case shall heat be added that would raise the stream temperature above 90 degrees Fahrenheit."

ii. Federal Thermal Discharge Regulations

Final effluent Guidelines and Standards for Steam Electric Power Facilities were published in the Federal Register on October 8, 1974. Essential points stressed in these guidelines are summarized briefly here.

- Thermal Discharge Standards

  Neal Unit 4 is required under Section 306 of the FWPCAA to achieve Standards of Performance for New Sources. These Standards require that: "There shall be no discharge of heat from the main condensers except: (1) Heat may be discharged in blowdown from recirculated cooling water systems provided the temperature at which the blowdown is discharged does not exceed at any time the lowest temperature of recirculated cooling water prior to the addition of the make-up water. (2) Heat may be discharged in blowdown from cooling ponds provided the temperature at which the blowdown is discharged does not exeed at any time the lowest temperature of recirculated cooling water prior to the addition of the make-up water." However, Section 316(a) of the FWPCAA does provide a means for further consideration of modification of thermal effluent limitations on a case by case basis.

At the time an application for an NPDES permit is filed the applicant is eligible to notify the EPA Regional Administrator that imposition of alternative thermal effluent limitations is requested under Section 316(a) of the FWPCAA and to submit evidence in support of this request. Section 316(a) provides that:

> "With respect to any point source otherwise subject to the provisions of Section 301 or Section 306 of this Act, whenever the owner or operator of any such source, after opportunity for public hearing, can demonstrate to the satisfaction of the Administrator (or if appropriate, the State) that any effluent limitation proposed for the control of the thermal component of any discharge from such source will require effluent limitations more stringent than necessary to assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water into which the discharge is to be made, the Administrator (or, if appropriate, the State) may impose an effluent limitation under such sections for such plant, with respect to the thermal component of such discharge (taking into account the interaction of such thermal component with other pollutants), that will assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on that body of water."

iii. Thermal Prediction Model

Missouri River ambient temperature characteristics in the vicinity of the Neal Station were evaluated and presented in Section III-B.

The mathematical model used in this study is the Prych-Davis-Shirazi model. This surface jet model was originally analyzed by Prych*1 utilizing Morton, Taylor and Turner's*2 integral approach. Recently, Shirazi and Davis*3 improved this model by calibrating it with prototype and series experimental results.

Prych-Davis-Shirazi's thermal model appropriately considers: hydrological and physical characteristics of the Missouri River (Reference III-B-11), such as: volume of flow, velocity of flow and cross-sectional area of the river*4; meteorological factors; such as: wind speed, air temperature and wet bulb temperature; plant operational characteristics such as: temperature rise at the discharge point, rate of discharge (volume, velocity) and plant capacity factor; engineering details of the discharge structure, such as: angle of discharge, depth of discharge and width of discharge.

iv. Temperature Rise Predictions

The Missouri River temperature rise at the Unit 4 discharge due to the operation of Units 1 - 3 was understood to be the completely mixed temperature rise resulting from the Units 1 - 3 discharge[39,40]. Previous analysis (Reference III-B-11) has shown that the heated water discharge of Units 1 - 3 will be completely mixed in the river by the time it reaches the Unit 4 discharge structure location.

The impact of Units 1 - 3 downstream of the Unit 4 discharge represented as the completely mixed temperature rise is tabulated below for various river flow conditions.

River Flow Rate (cfs)	Units 1-3 Discharge Rate (cfs)	Units 1-3 Capacity Factor (percent)	Units 1-3 Condenser Temperature Rise (°F)	Completely Mixed Temperature Rise For Units 1-3 (°F)
6000*	1093	100	19.5	3.51
6000	1093	85	16.5	2.97
6500**	1093	100	19.5	3.24
20000***	1093	100	19.5	1.07

* 1 in 10 year MA7CDLF for Non-Navigation Season (Iowa DEQ-Section III-B).

** 1 in 10 year MA7CDCF for Non-Navigation Season (Ebasco - Section III-B).

*** 1 in 10 year MA7CDLF for Navigation Season (Ebasco - Reference III-B-4).

The effective allowable temperature rise for the Unit 4 discharge was computed by calculating the difference between the allowable 5° F criterion and the completely mixed temperature rise presented above. The allowable temperature rises for the Unit 4 discharge at various river flow conditions are presented below.

River Flow Rate (cfs)	Unit 4 Discharge (cfs)	Unit 4 Capacity Factor (precent)	Unit 4 Condenser Temperature Rise (°F)	Allowable Temperature Rise Outside The Mixing Zone (°F)
6000	705	100	17	1.49
6000	705	85	14.5	2.03
6500	705	100	17	1.76
20000	705	100	17	3.93

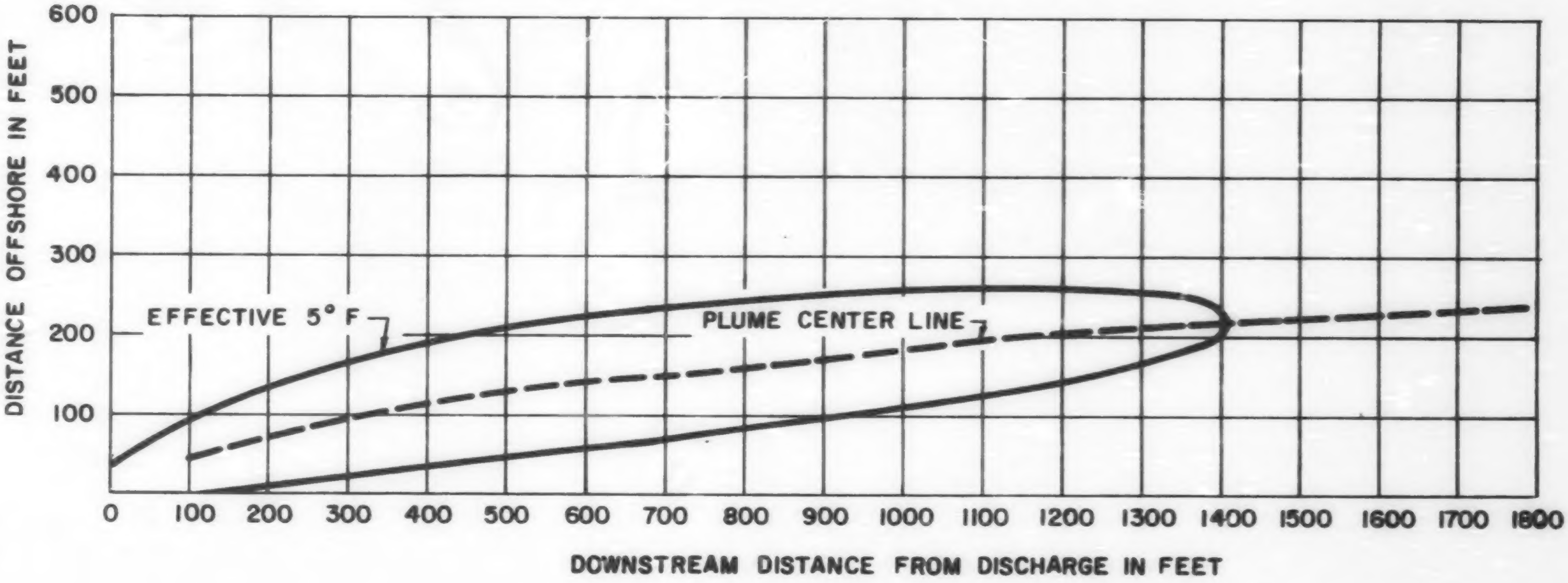
Exhibit IV-B-2 presents the predicted isotherm of the 1.49° F allowable temperature rise (ie, 5° F effective temperature rise considering effects of Units 1-3) for a river flow of 6000 cfs and Units 1-4 all operating at 100 percent capacity factor. The Unit 4 discharge velocity is 6 fps which is the minimum value proposed for low flow operation and represents the most conservative (high) case with respect to thermal plume prediction. The downstream and off-stream extents of this isotherm are 1410 ft and 260 ft, respectively. The maximum cross-sectional area of the Missouri River affected by the effective 5° F temperature rise is 35 percent of the full river cross-sectional area.

Exhibit IV-B-3 presents the predicted isotherm of the 2.03° F allowable temperature rise (ie, 5° F effective temperature rise) for a river flow of 6000 cfs and Units 1-4 all operating at 85 percent capacity factor. This value is representative of daily average sustained plant operation (Reference III-B-11). The Unit 4 discharge velocity is 6 fps. The downstream and offstream extents of the effective 5° F isotherm are 980 ft and 210 ft, respectively. The maximum cross-sectional area affected is 24 percent.

Exhibit IV-B-4 presents the predicted isotherm of the 1.76° F allowable temperature rise (ie, 5° F effective temperature rise) for a river flow of 6500 cfs and Units 1-4 all operating at 100 percent capacity factor. The Unit 4 discharge velocity is 6 fps. The downstream and offstream distances and maximum cross-section area affected are 1140 ft, 230 ft and 27 percent, respectively.

Exhibit IV-B-5 presents the predicted isotherm of the 3.93° F allowable temperature rise (ie, 5° F effective temperature rise) for a river flow of 20,000 cfs and Units 1-4 all operating at 100 percent capacity factor. The Unit 4 discharge velocity is 4 fps which is the minimum value proposed for average flow operation and represents the most conservative (high) case with respect to thermal plume prediction. The downstream and offstream distances

RIVER FLOW RATE : 6000 cfs
RIVER VELOCITY : 1.2 fps
JET VELOCITY : 6 fps
PLANT CAPACITY FACTOR : 100 PERCENT
CONDENSER TEMPERATURE RISE: 17°F



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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

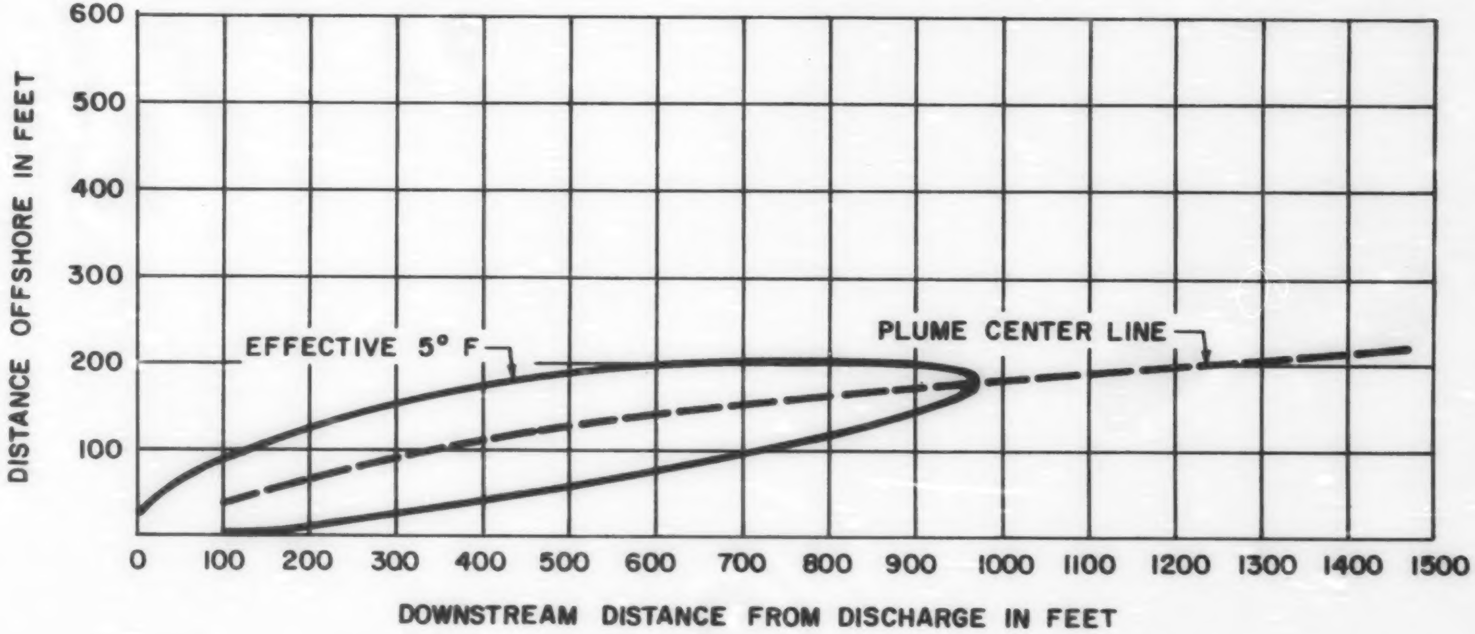
THERMAL PLUME ANALYSIS OF THE UNIT 4 DISCHARGE

DATE:

SCALE:

EXHIBIT
IV-B-2

RIVER FLOW RATE: 6,000 cfs
RIVER VELOCITY: 1.2 fps
JET VELOCITY: 6 fps
PLANT CAPACITY FACTOR: 85 PERCENT
CONDENSER TEMPERATURE RISE: 14.5°F



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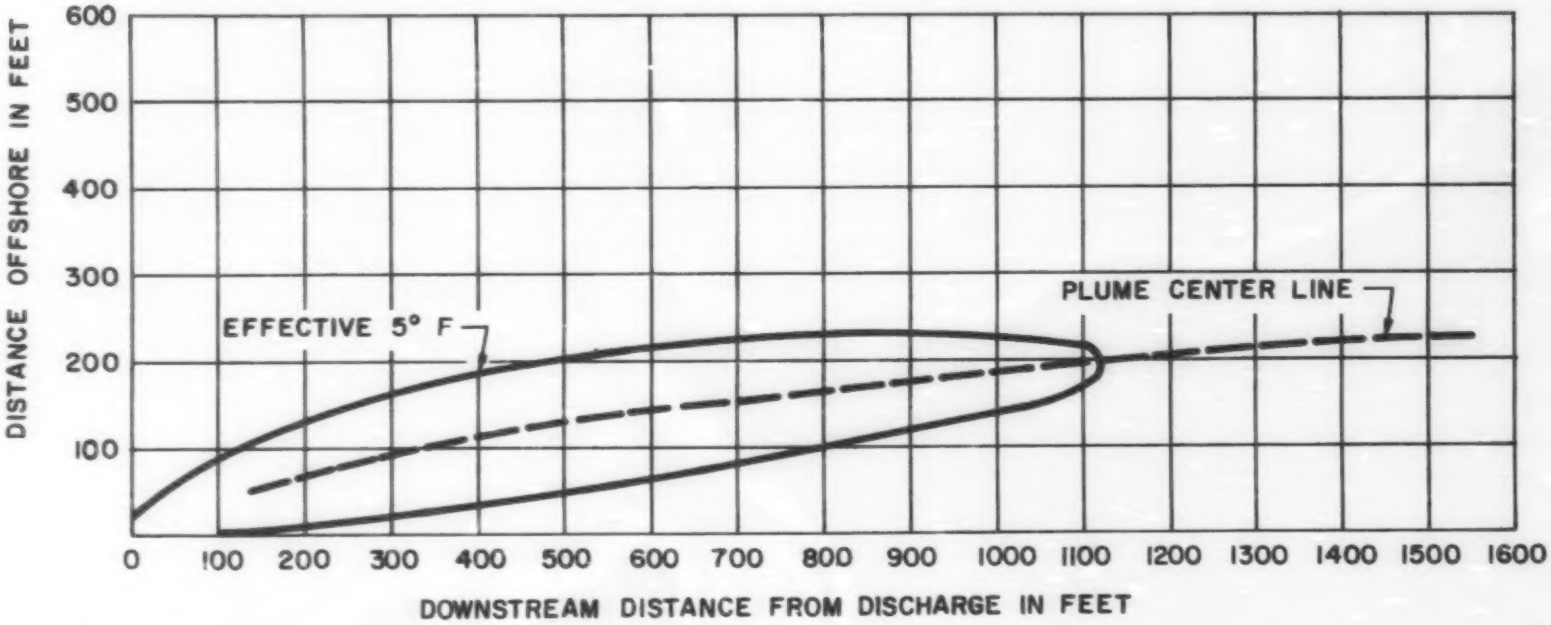
IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

THERMAL PLUME ANALYSIS OF THE UNIT 4 DISCHARGE

DATE:

SCALE:

EXHIBIT
IV-B-3



RIVER FLOW RATE: 6,500 cfs
RIVER VELOCITY: 1.2 fps
JET VELOCITY: 6 fps
PLANT CAPACITY FACTOR: 100 PERCENT
CONDENSER TEMPERATURE RISE: 17°F

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

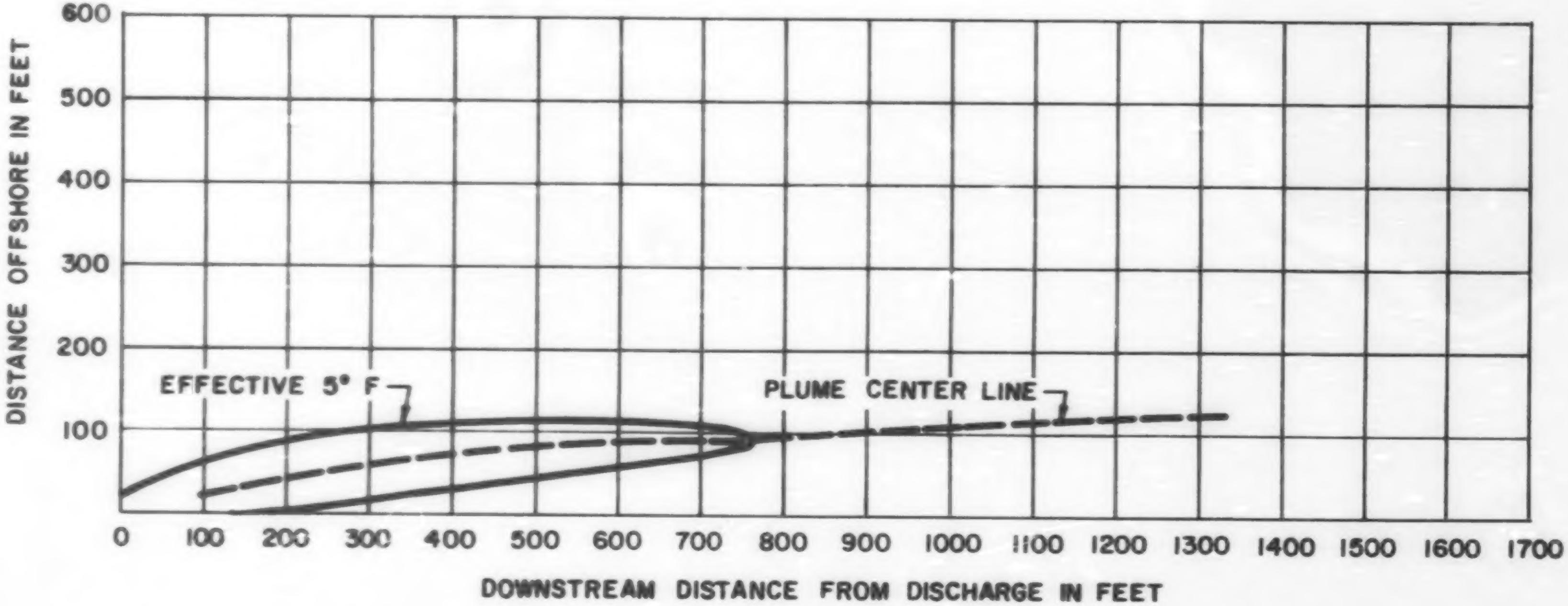
THERMAL PLUME ANALYSIS OF THE UNIT 4 DISCHARGE

DATE:

SCALE:

EXHIBIT
IV-B-4

RIVER FLOW RATE: 20,000 cfs
RIVER VELOCITY: 2.4 fps
JET VELOCITY: 4 fps
PLANT CAPACITY FACTOR: 100 PERCENT
CONDENSER TEMPERATURE RISE: 17°F



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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

THERMAL PLUME ANALYSIS OF THE UNIT 4 DISCHARGE

DATE:

SCALE:

EXHIBIT
IV-B-5

and the maximum cross-sectional area affected are 770 ft, 120 ft, and 5 percent, respectively.

v. Results of the Thermal Analysis

For a flow of 6000 cfs and the Neal Station (4 units) operating at 100 percent capacity factor, the maximum cross-sectional area affected by the 5° F effective temperature rise isotherm is 35 percent of the full river cross-sectional area, assuming a Unit 4 discharge velocity of 6 fps.

For, the same flow of 6000 cfs and the station (4 units) operating at 85 percent capacity factor and a Unit 4 discharge velocity of 6 fps, the maximum cross-sectional area affected by the 5° F effective temperature rise isotherm will not exceed 25 percent of the full river cross-sectional area.

At a flow of 6500 cfs, discharge velocity of 6 fps and the station (4 units) operating at 100 percent capacity factor, the maximum cross-sectional area affected by the 5° F effective temperature rise isotherm will not exceed 27 percent of the full river cross-sectional area. Based on the results at a flow of 6000 cfs, thermal criteria would be satisfied at 6500 cfs, 6 fps and 85 percent capacity factor.

For a river flow of 20,000 cfs, and 100 percent capacity factor, the maximum cross-sectional area affected by the 5° F effective temperature rise isotherm is estimated to be 5 percent of the full river cross-sectional area.

b. Effects on Other Water Quality Parameters

The impact on water quality associated with the discharge of once through cooling water should be negligible since no biocide additions will be made. The only effect will be a slight alteration in the $CaCO_3$ equilibriums resulting from an increase in temperature. The Langelier Saturation Index (LSI) is commonly employed to calculate the state of the system with regard to $CaCO_3$ equilibrium. A negative LSI indicates that $CaCO_3$ is undersaturated and a positive LSI indicates a concentration exceeding saturation. As the LSI is affected by temperature, an increase in temperature will result in an increase in the LSI. Using the data presented in Section III-C and assuming that calcium hardness is approximately 65 percent of the total hardness, an LSI of +0.5 is calculated. A temperature increase of 17° F will result in an LSI of +0.7. The increase in LSI is of no consequence, since the increase is temporary and will return to ambient levels as the temperature returns to ambient.

c. Effects on Aquatic Ecology

Waste heat should be the primary source of impact on the Missouri River due to coolant discharge. Substances associated with the chemical waste system will be treated to meet effluent standards prior to discharge. These wastes are discussed in Section IV-E. No adverse effects should be noted in the Missouri River. The levels of ammonia upstream of the plant site could be a significant problem if Neal 4 were located above the existing generating station, but concentrations at the Neal 4 site are less than 0.5 mg/l (Exhibit III-C-7).

Effects of temperature on aquatic organisms have been extensively reviewed[15, 22, 45, 46, 47, 48, 49, 50]. The Environmental Protection Agency[45, 51] has excerpted data from numerous publications on the effects of temperature on aquatic organisms, and Bush, et al[50] have synthesized data in the form of predicted displacement temperatures for fish indigenous to six North American rivers.

At the primary producer level, Bott et al[8] pointed out that replacement of diatoms by green algae usually takes place at about 30° C (86° F). Temperatures approaching these optimum ranges could be achieved within the 10° F (5.56° C) ΔT isotherm from late July through August at Neal Unit 4. Based on these data and the predicted temperative isotherms from Neal Unit 4, localized short-term increases in green and blue-green algae can be expected on the rocks below Neal Unit 4. However, periphyton studies taken in relation to the existing once-through circulating water system at Neal Units 1-2, showed no clear-cut patterns of diatom, green, and blue-green algae abundance above and below that discharge (Appendix Table A-IV-B-5). Plankton studies at the Neal site have not revealed any consistent or important upstream/downstream differences due to present thermal discharges either (Section III-C and Appendix Table A-IV-B-1), and thus it is expected that the discharge from Neal 4 will not significantly affect the distribution and abundance of algae in the Missouri River.

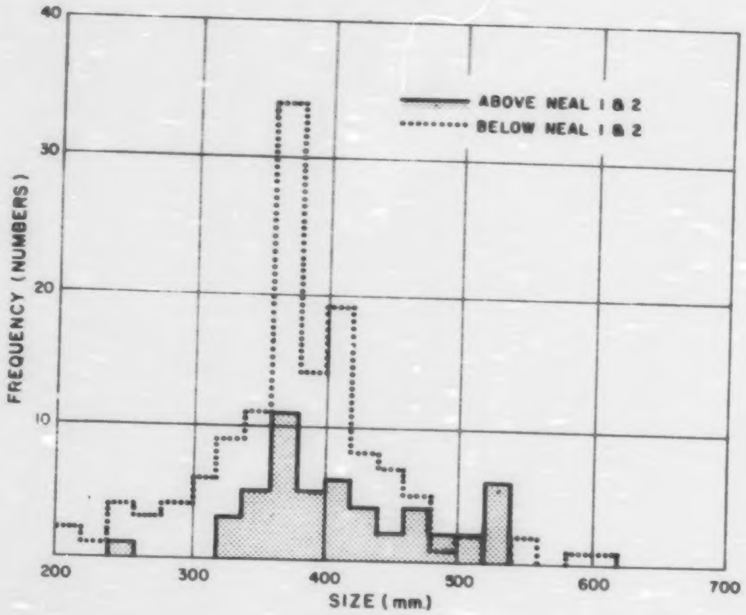
The importance of zooplankton to the river ecosystem has been discussed in Section IV-B-1. Lethal temperatures reported by Bush et al[50] for zooplankton are generally higher than predicted plume temperatures (e.g. 30° - 38.5° C for Cyclops spp and 27° - 44° C for Daphnia spp). Individual zooplankton are exposed to plume temperatures for limited time periods as they are washed downstream. For these reasons, no substantial impact to the ecosystem as a result of zooplankton exposure to the warm water discharge is expected.

Benthic invertebrates are also thought to contribute little to the Missouri River ecosystem at the Neal site. Because the benthos is restricted in terms of movement, exposure to plume temperature is long term. The potential for effects is thus greatly increased. However, abundance and distribution of invertebrates on colonizing test panels below Neal Unit 1 and 2 was not systematically affected by the surface discharge of warm water (Section III-C). There is no reason to expect that the warmed water from the Unit 4 surface discharge would cause a different effect.

Appendix Table A-IV-B-6 presents a compilation of tolerance, preference, or required temperatures of important fish species at Neal Unit 4. Unless otherwise indicated, lethal thresholds represent median tolerance limits. The data are more complete for some species than others, based on availability in the literature. It is evident that some of the most important species; e.g., channel catfish, northern pike, carp, carpsucker, and bullhead, exhibit high temperature tolerances as juveniles or adults, and should not be adversely affected by the Neal Unit 4 discharge. However, most of these would probably avoid the immediate area of the discharge (50 ft radius) in mid-summer.

Data obtained upstream (control area) and downstream (affected by thermal discharge) of Neal Units 1 and 2 by Hey and Baldwin[31], [52], [53] indicated a tendency for fish, particularly carp and carpsucker, to be more concentrated in the plume area than above it. In studies conducted from June to November 1974[53], it was concluded that when ambient river temperatures were below 70° F, fish, especially carpsucker, were attracted to the plume area when compared to a downstream control. However, when ambient river temperatures were above 70° F, fish did not appear to be attracted to the discharge plume. Length-frequencies of these species in April and May 1974 are shown in Exhibits IV-B-7 and 8. It is apparent that, although lengths were similar in the two reaches, numbers were greater below the plant. Additionally, differences in condition factors, expressing relative "robustness" of fish, were statistically significant between upstream and downstream groups, downstream individuals displaying higher weights per unit length (Table IV-B-9). No data are available at Neal Units 1 and 2 regarding the growth of channel catfish above and below the plant. Andrews and Stickney[54] reported that fingerlings grew best at 30° C in their lab experiments, which suggests that growth may be enhanced in the Missouri River for much of the year.

Distribution of other fishes listed in Appendix Table A-IV-B-6 may be affected differently by Neal Unit 4 discharge. For example, in the April-November 1974 thermal plume attraction study,[53],[55] smallmouth buffalo was generally more abundant in the warmed discharge plume than it was in control areas. However, numbers are not large enough to permit statistical treatment of possible plume attraction. Gammon[56] indicated that goldeye and smallmouth buffalo, as well as freshwater drum, gizzard shad, white crappie, and white bass, selected the coolest thermal regime available to them in summer at the Wabash, Indiana plant. Based on data in Appendix Table A-IV-B-6, a similar pattern for Neal Unit 4 is predicted. Sauger, white sucker and redhorse would probably avoid mid-summer plumes. Their summer preferences are given as 27-29° C,[56] 19-21° C[48]; and 26-27.5° C[56]; respectively. None of the species present at Neal Unit 4 should experience temperature-related mortalities. They may avoid the immediate area of the discharge plume in mid-summer, but should be attracted to it during the rest of the year. Temperature differences within a few hundred feet of the discharge on the



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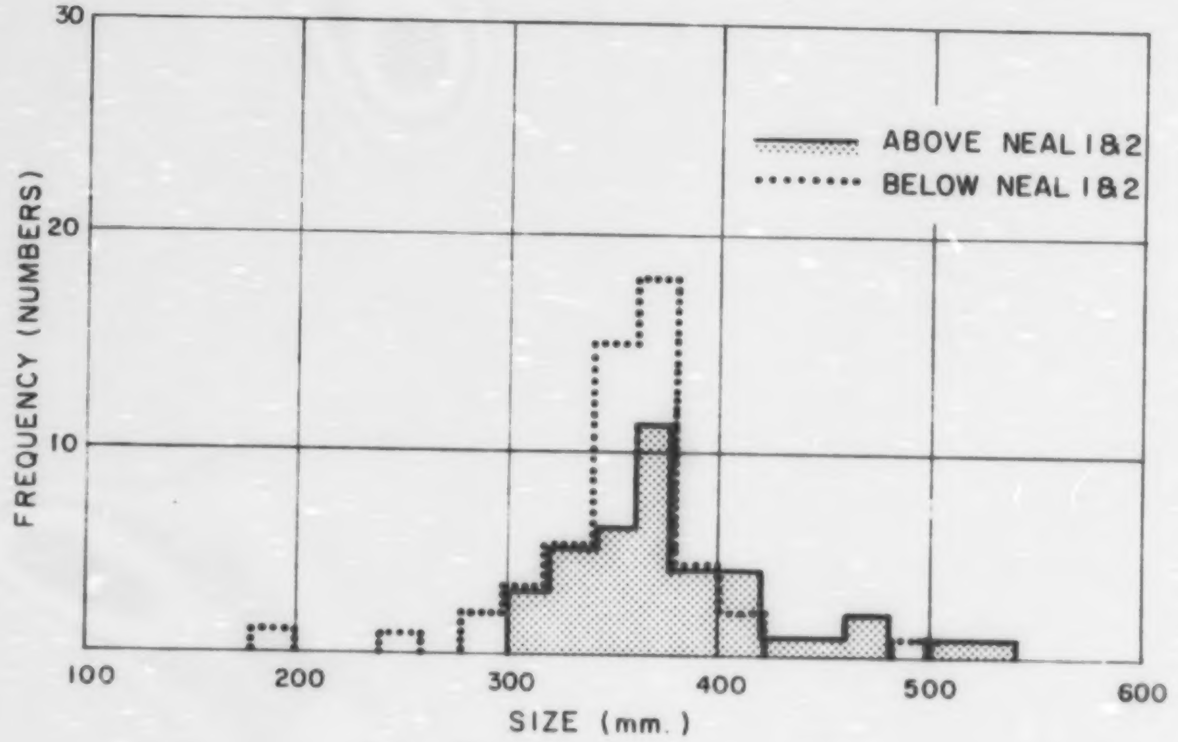
IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

LENGTH-FREQUENCY DISTRIBUTIONS OF CARP TAKEN UPSTREAM AND DOWNSTREAM OF NEAL 1&2 BY ELECTROSHOCKING, APRIL - MAY, 1974

DATE:

SCALE:

EXHIBIT IV-B-7



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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

LENGTH-FREQUENCY DISTRIBUTIONS OF CARPSUCKER TAKEN UPSTREAM AND DOWNSTREAM OF NEAL 1&2 BY ELECTROSHOCKING, APRIL - MAY 1974

DATE:

SCALE:

EXHIBIT
IV-B-8

Species	Number	Range of K*	Mean K	Median K	Significance of Difference
Carp					
Upstream	51	1.05 - 1.89	1.34	1.34	P = .0009
Downstream	134	0.62 - 4.26	1.52	1.43	
Carpsucker					
Upstream	35	0.53 - 1.89	1.22	1.22	P = .003
Downstream	51	0.83 - 2.47	1.30	1.37	

$K = \frac{100,000\ W}{L^3}$ where W = weight (gms) and L = length (mm)

* Mann - Whitney U Test (Steel[37])

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

CONDITION FACTORS OF CARP AND CARPSUCKER TAKEN UPSTREAM AND DOWNSTREAM OF NEAL 1 AND 2 BY ELECTROFISHING APRIL-MAY 1974

DATE:

SCALE:

TABLE IV-B-9

Iowa shore would raise temperatures above spawning and egg and larval development requirements for most species in May, June, and July. However, no important spawning grounds have been recognized there. One possible species which may spawn near the site is the channel catfish. Improved reproductive success of this species below a power plant on the Wabash River, Indiana has been indicated by Gammon[87]. Species with lower spawning temperature requirements, namely sauger, white crappie, northern pike, carp, and white sucker, spawn in different habitats.

d. Effect on other Water Users

Neal Unit 4 is not expected to affect the chemical composition of the Missouri River other than as described in Section IV-B-2-b. Also, no other industries are present immediately below Neal Unit 4 which could require cooling water. Thus, the circulating water system will have no effect on downstream water users.

During the winter months, the Neal Unit 4 discharge will affect river ice formation in the vicinity of the plant and immediately downstream of the discharge structure. However, there should be no measurable impact on ice formation downstream of Synder Bend and, subsequently, no occurrences of downstream flooding.

C. ATMOSPHERIC EMISSIONS

1. Description of Basic Predictive Methodology

Ground level concentrations of plant emissions were calculated for 138 grid points within approximately 10 kilometers of the Neal site (see Exhibit IV-C-1). Consideration was given in the grid selection task to those areas around the site which were most likely to experience high calculated ground level concentrations of contaminants. The basic rationale used in selecting the grid system is detailed below.

Areas likely to be impacted by looping plumes during unstable atmospheric conditions were covered by an inner circular grid surrounding Units 1-3 and another surrounding Unit 4 at distances of from 1-2 km.

Areas likely to experience highest concentrations under neutral atmospheric conditions, or during incidents of plume trapping due to an elevated inversion, were covered with an outer circular grid at distances from 5-9 km from Units 1-3.

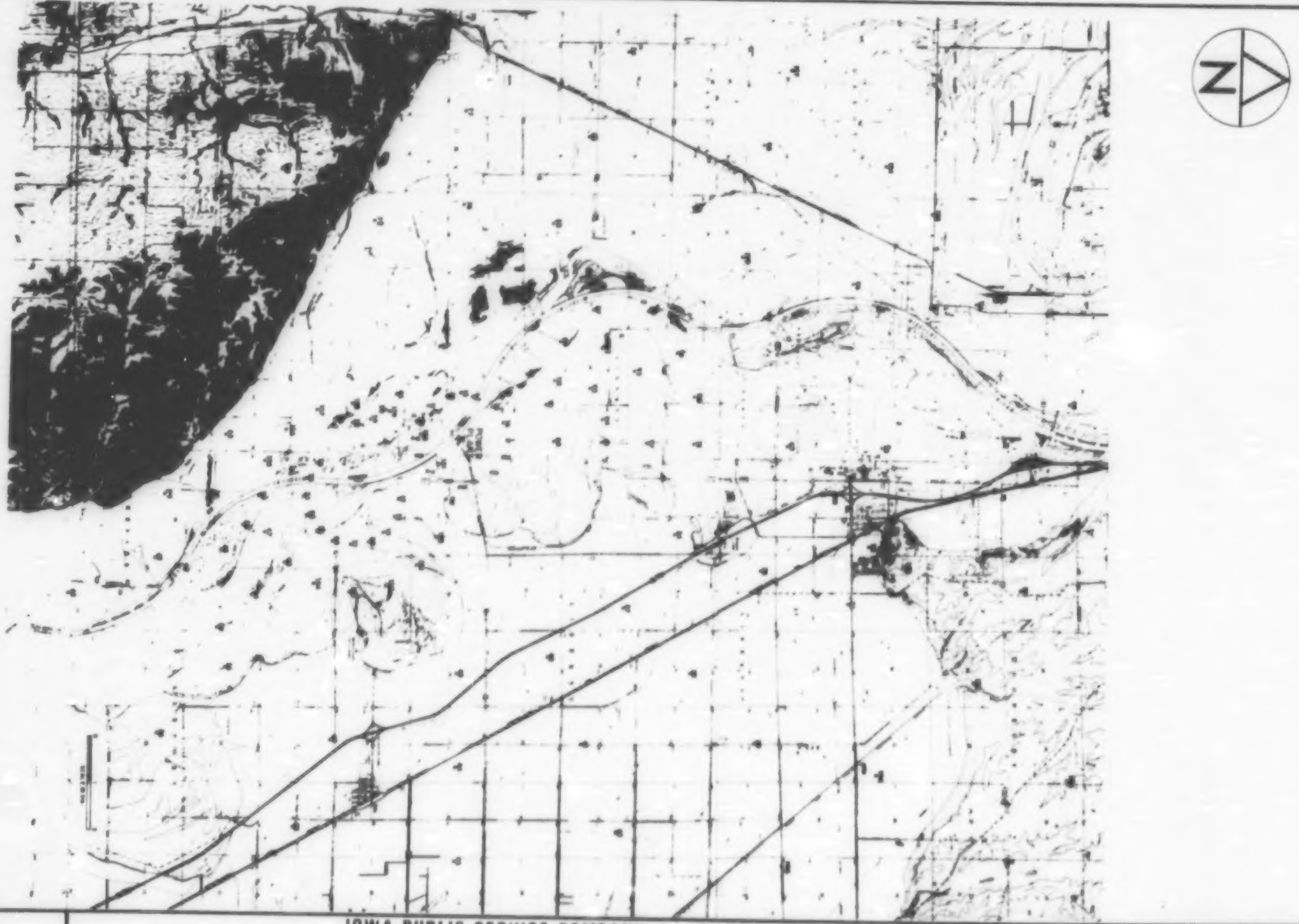
Additional grid points were placed in the areas of elevated terrain southwest and north-northeast of the site, since these areas could experience high concentrations due to plume impaction during stable atmospheric conditions.

Since the diffusion model utilized for the calculations considers the physical separation of the stacks, the grid density was increased in directions for which the stacks would be aligned (i.e., NW, NNW, N and S, SSE, SE). It is in these areas that the emissions of all four units could impact simultaneously, resulting in high ground level concentrations of air contaminants.

The elevation of each grid point was determined from United States Geological Survey topographic maps of the area. In cases where higher terrain existed in close proximity to a particular grid point, the higher elevation was utilized for the grid point. The locations and elevations of each of the grid points are listed in Table IV-C-1.

The computerized atmospheric diffusion model employed for this study uses plant design and operating parameters, hourly surface meteorological data and twice daily radiosonde (upper air) data as inputs. One full year was chosen based on an examination of the meteorological data for the years 1960-1964. Both surface and upper air data were readily available from the National Weather Service in a computer-compatible format.

This examination indicated that the year 1963 exhibited poorer diffusion characteristics (i.e., lower average wind speeds and higher frequencies of both very unstable and stable conditions) than the other years considered. Another earlier



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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

LOCATIONS OF GRID POINTS FOR AIR QUALITY STUDY

DATE:

EXHIBIT

EXHIBIT
IV-C-1

Grid Point Number	from Unit 2 Stack		Elevation	SO_2			NO_2	Particulates		H_2SO_4	
	Distance (meters)	Direction (+/- 11.25°)		3-hour Average	24-hour Average	Annual Average	Annual Average	24-hour Average	Annual Average	24-hour Average	Annual Average
1	1000	N	1076	469	64	1.79	1.22	3	0.10	1	0.04
2	1000	NNE	1076	908	125	1.79	1.24	6	0.10	1	0.04
3	1000	NE	1074	638	80	1.40	0.93	4	0.08	2	0.03
4	1000	ENE	1078	438	61	0.90	0.57	3	0.05	1	0.02
5	1000	E	1074	262	36	0.83	0.53	2	0.05	1	0.01
6	1000	ESE	1074	468	62	1.10	0.71	3	0.05	1	0.01
7	1000	SE	1075	687	87	1.41	0.97	4	0.07	1	0.01
8	1000	SSE	1065	744	93	1.38	0.97	4	0.07	1	0.01
9	1000	S	1070	286	36	0.80	0.56	2	0.04	1	0.01
10	1000	SSW	1071	416	52	1.12	0.77	3	0.06	3	0.02
11	1000	SW	1075	379	50	1.12	0.75	2	0.06	1	0.02
12	1000	WSW	1075	282	36	0.81	0.53	1	0.04	1	0.02
13	1000	W	1075	131	24	0.63	0.41	1	0.04	2	0.03
14	1000	WNW	1065	128	16	0.70	0.44	1	0.04	1	0.03
15	1000	NW	1082	296	37	1.15	0.78	2	0.07	2	0.04
16	1000	NNW	1080	401	50	1.84	1.35	2	0.10	2	0.05
17	1538	SE	1080	443	80	2.59	2.01	4	0.13	6	0.04
18	2173	SE	1082	500	114	3.16	2.44	5	0.16	7	0.05
19	2562	SE	1075	458	107	3.32	2.57	5	0.16	8	0.07
20	2936	SE	1075	420	96	3.39	2.69	4	0.17	9	0.09
21	3253	SE	1080	369	81	3.39	2.74	4	0.17	9	0.08
22	3485	SE	1075	362	69	3.36	2.74	3	0.17	8	0.09
23	3615	SSE	1070	298	50	3.28	2.68	3	0.17	6	0.10
24	3547	SSE	1070	294	50	3.19	2.63	2	0.16	9	0.09
25	3352	SSE	1065	335	56	3.25	2.61	3	0.16	6	0.08
26	3065	S	1067	419	69	2.70	2.07	3	0.13	5	0.06
27	2709	S	1070	304	50	1.39	1.01	2	0.07	3	0.03
28	2319	S	1073	336	63	1.46	1.04	3	0.07	3	0.03
29	1953	S	1070	409	58	1.69	1.22	3	0.08	3	0.03
30	1700	SSW	1065	527	78	1.93	1.43	4	0.09	2	0.03
31	5000	N	1095	261	49	3.45	2.51	2	0.18	2	0.09
32	7000	N	1090	210	54	3.37	2.42	3	0.17	3	0.13
33	9000	N	1095	220	58	3.22	2.29	3	0.16	4	0.16
34	5000	NNE	1089	493	107	3.32	2.39	5	0.17	7	0.09
35	7000	NNE	1092	378	82	3.21	2.28	4	0.16	7	0.11
36	9000	NNE	1089	314	67	3.13	2.18	3	0.15	7	0.15
37	5000	NE	1085	237	45	1.68	1.15	2	0.09	4	0.08
38	7000	NE	1086	221	30	1.49	1.03	1	0.08	4	0.08
39	9000	NE	1086	176	27	1.44	0.99	1	0.07	5	0.11
40	5000	ENE	1080	246	36	1.13	0.78	2	0.06	10	0.08
41	7000	ENE	1084	193	30	0.91	0.64	1	0.05	9	0.08
42	9000	ENE	1082	164	25	0.94	0.65	1	0.05	8	0.10
43	5000	E	1083	328	55	1.46	1.02	2	0.07	7	0.08
44	7000	E	1080	233	53	1.24	0.89	2	0.06	7	0.10
45	9000	E	1078	179	43	1.29	0.92	2	0.06	6	0.14
46	1685	SW	1065	571	71	1.90	1.38	3	0.09	2	0.04

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

MAXIMUM PREDICTED SO_2, NO_2, PARTICULATE
AND H_2SO_4 CONCENTRATIONS NEAL UNITS 1-4
FOR EACH GRID POINT
(ug/m3)

DATE:

SCALE:

TABLE
IV-C-1

Grid Point Number	from Unit 2 Stack			SO_2			NO_2	Particulates		H_2SO_4	
	Distance (meters)	Direction (+/-11.25°)	Elevation	3-hour Average	24-hour Average	Annual Average	Annual Average	24-hour Average	Annual Average	24-hour Average	Annual Average
47	4634	SSE	1070	349	54	3.57	2.82	3	0.18	9	0.13
48	5632	SSE	1070	332	56	3.99	3.13	3	0.20	6	0.16
49	7000	ESE	1080	197	51	1.99	1.48	2	0.10	4	0.11
50	9000	ESE	1080	158	50	1.98	1.46	2	0.10	3	0.14
51	1414	NW	1080	460	72	1.95	1.48	4	0.11	2	0.05
52	4600	SE	1080	422	79	3.76	2.95	4	0.19	13	0.15
53	3637	NNE	1065	259	39	3.06	2.51	2	0.15	9	0.10
54	5592	SE	1073	427	85	4.20	3.23	4	0.21	16	0.19
55	7000	SE	1070	439	95	4.46	3.36	5	0.22	18	0.26
56	9000	SE	1076	358	75	4.81	3.52	4	0.24	18	0.36
57	6583	SE	1063	369	73	4.27	3.24	4	0.21	17	0.23
58	4492	SSE	1065	250	42	3.61	2.91	2	0.18	7	0.10
59	5457	SSE	1075	372	66	3.77	2.98	3	0.19	3	0.12
60	5000	SSE	1073	314	54	4.00	.15	3	0.20	8	0.14
61	7000	SSE	1072	301	54	4.51	3.48	3	0.23	6	0.21
62	9000	SSE	1070	246	48	4.86	3.62	2	0.24	13	0.32
63	5000	S	1080	194	34	1.66	1.25	2	0.09	4	0.07
64	6000	S	1175	172	39	1.98	1.55	2	0.10	4	0.11
65	7000	S	1300	294	53	2.96	2.32	3	0.15	7	0.23
66	9000	S	1210	194	46	2.28	0.72	2	0.11	6	0.23
67	5000	SSW	1360	700	96	3.79	3.06	5	0.19	6	0.19
68	7000	SSW	1380	877	123	4.17	3.30	6	0.21	12	0.34
69	9000	SSW	1370	795	109	3.88	2.99	6	0.19	15	0.41
70	5000	SW	1320	295	75	2.00	1.55	4	0.10	4	0.11
71	7000	SW	1400	351	85	2.58	1.99	4	0.13	8	0.24
72	9000	SW	1400	329	70	2.50	1.88	3	0.12	11	0.30
73	5000	WSW	1089	207	35	0.95	0.70	2	0.05	3	0.06
74	7000	WSW	1450	773	130	3.98	3.35	7	0.20	24	0.59
75	9000	WSW	1350	358	59	2.06	1.64	3	0.10	12	0.29
76	5000	W	1080	149	37	1.00	0.76	2	0.05	8	0.09
77	7000	W	1090	143	36	1.16	0.92	2	0.06	7	0.12
78	9000	W	1100	142	46	1.40	1.10	2	0.07	7	0.19
79	6433	SSE	1073	336	58	3.36	2.61	3	0.17	6	0.13
80	2000	N	1075	332	6_	3.08	2.26	3	0.16	2	0.06
81	3000	N	1075	316	57	3.48	2.51	3	0.18	3	0.08
82	5000	WNW	1080	389	56	2.12	1.62	3	0.11	6	0.17
83	7000	WNW	1090	316	51	2.64	2.03	2	0.14	13	0.31
84	9000	WNW	1093	256	44	2.95	2.25	2	0.15	13	0.43
85	2000	NW	1080	537	104	3.00	2.24	5	0.16	2	0.09
86	3000	NW	1080	372	88	3.[illegible]8	2.52	4	0.17	4	0.14
87	4000	NW	1080	430	64	3.42	2.58	3	0.17	6	0.18
88	5000	NW	1086	367	71	3.59	2.79	3	0.18	4	0.22
89	7000	NW	1090	299	57	4.23	3.28	3	0.22	6	0.37
90	9000	NW	1095	260	58	4.69	3.58	3	0.24	7	0.56
91	2000	NNW	1078	597	158	5.51	4.20	8	0.28	7	0.14
92	3000	NNW	1090	484	118	6.64	4.58	6	0.33	7	0.23

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

MAXIMUM PREDICTED SO_2, NO_2, PARTICULATE
AND H_2SO_4 CONCENTRATIONS NEAL UNITS 1-4
FOR EACH GRID POINT
(ug/m3)

DATE:

SCALE:

TABLE
IV-C-1
(cont'd)

Grid Point Number	from Unit 2 Stack			SO$_2$			NO$_2$	Particulates		H$_2$SO$_4$	
	Distance (meters)	Direction (+/-11.25^o)	Elevation	3-hour Average	24-hour Average	Annual Average	Annual Average	24-hour Average	Annual Average	24-hour Average	Annual Average
93	4000	NNW	1095	534	126	6.64	4.96	6	0.33	7	0.28
94	5000	NNW	1095	491	116	6.85	5.15	6	0.34	8	0.34
95	7000	NNW	1080	386	92	7.08	5.27	4	0.36	9	0.47
96	9000	NNW	1082	351	77	7.35	5.35	4	0.37	10	0.67
97	4000	N	1090	288	48	3.36	2.44	2	0.17	2	0.08
98	6631	NNE	1070	331	58	4.24	3.30	3	0.21	6	0.20
99	13038	N	1098	176	48	3.17	2.17	2	0.16	5.	0.87
100	14765	NNE	1250	178	47	2.79	1.92	2	0.14	6	0.24
101	12369	NNE	1300	375	50	4.37	3.07	2	0.21	10	0.36
102	12083	NNE	1200	252	53	3.19	2.21	3	0.16	7	0.21
103	11190	NNW	1100	218	77	7.50	5.38	4	0.37	12	0.81
104	10817	NNW	1097	219	61	6.33	4.60	3	0.32	13	0.73
105	9823	NNE	1300	409	57	4.76	3.40	3	0.24	9	0.29
106	11402	NE	1094	145	24	1.48	1.00	1	0.07	5	0.12
107	10630	NW	1095	197	73	5.12	3.87	4	0.26	10	0.80
108	11402	NE	1083	143	32	0.95	0.65	2	0.05	4	0.10
109	7211	NNW	1090	328	71	5.86	4.40	3	0.30	6	0.39
110	5099	NNW	1092	345	79	6.13	4.56	4	0.31	5	0.28
111	4883	NW	1080	396	76	4.93	3.71	4	0.25	7	0.23
112	3606	NNW	1090	445	97	5.50	4.08	5	0.28	8	0.21
113	2385	NNW	1082	616	116	5.26	3.90	6	0.27	7	0.15
114	3041	N	1086	421	125	5.20	3.89	6	0.26	5	0.17
115	8950	NNE	1090	202	49	3.40	2.41	2	0.17	6	0.16
116	11428	NNW	1098	220	86	7.77	5.54	4	0.39	14	0.87
117	10440	NNW	1097	258	89	7.93	5.71	4	0.40	14	0.82
118	8062	N	1095	191	49	3.29	2.37	2	0.16	3	0.14
119	1334	E	1086	307	38	0.97	0.67	2	0.05	1	0.01
120	2113	E	1085	302	45	1.38	0.98	2	0.07	1	0.02
121	2855	E	1075	419	52	1.85	1.32	2	0.09	2	0.04
122	3502	ESE	1077	245	54	2.23	1.67	2	0.11	4	0.06
123	4022	SE	1075	333	83	3.14	2.44	3	0.15	7	0.10
124	4394	SE	1075	500	114	3.58	2.82	5	0.18	15	0.13
125	4182	S	1073	304	40	2.11	1.60	2	0.11	3	0.05
126	3716	S	1075	188	35	1.40	1.04	2	0.07	3	0.04
127	3114	S	1075	274	38	1.46	1.06	2	0.07	2	0.03
128	2404	SSW	1075	470	71	1.82	1.30	3	0.09	2	0.03
129	1630	SSW	1075	508	74	1.90	1.41	4	0.09	2	0.03
130	893	S	1065	190	24	0.70	0.46	1	0.04	1	0.01
131	700	SE	1080	511	67	1.09	0.72	3	0.06	1	0.02
132	8062	WSW	1380	937	122	3.09	2.47	6	0.16	5	0.26
133	10000	SW	1410	582	77	3.04	2.30	4	0.15	7	0.33
134	7280	SSW	1350	505	76	4.06	3.28	4	0.21	12	0.34
135	8246	SSW	1440	1153	158	7.11	5.77	8	0.36	4	0.69
136	8602	SW	1320	326	45	2.45	1.86	2	0.12	6	0.25
137	7661	SW	1450	767	92	3.96	3.09	5	0.20	12	0.38
138	6907	SW	1440	826	103	4.04	3.29	6	0.20	18	0.43

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

MAXIMUM PREDICTED SO$_2$, NO$_2$, PARTICULATE
AND H$_2$SO$_4$ CONCENTRATIONS NEAL UNITS 1-4
FOR EACH GRID POINT
(ug/m3)

DATE:

SCALE:

TABLE
IV-C-1
(cont'd)

diffusion analysis for this plant (Ebasco Services Incorporated¹) confirmed the occurrence of the highest predicted concentrations based on 1963 meteorological data.

The hourly surface meteorological data used were recorded at the National Weather Service first order station at Sioux City Airport, 8 km north of the site. Since radiosonde data are not recorded at Sioux City, the upper air data utilized in this analysis were obtained from the records of the National Weather Service first order station at Omaha, Nebraska, which at roughly 120 km south of the Neal Station, is the nearest source of radiosonde data. Both the surface and upper air meteorological data are reasonably representative of site conditions.

A detailed description of the operation of the STACK SELECT* diffusion model is presented in Appendix A-IV-C.

2. Federal Regulations

The National Ambient Air Quality Standards (NAAQS) are published in the Code of Federal Regulations as 40 CFR Part 50 and are presented in Table IV-C-2. The primary standards are pollutant concentration limits designed to protect human health. Secondary standards are welfare related. These standards were to be attained in the Iowa portion of the Metropolitan Sioux City Interstate Air Quality Control Region by July 1975 (40 CFR 52.827). Available monitoring data indicate that standards have been attained in this region.

New Source Performance Standards (NSPS) have been promulgated for power plants (40 CFR 60.40) and coal preparation facilities (40 CFR 60.250). Standards for power plants are presented in Table IV-C-3. These standards limit the amounts of particulates, sulfur dioxide and nitrogen oxides allowed to be emitted from new power plants and the amounts of particulates allowed from coal preparation facilities. The NSPS also require emission monitoring for opacity, sulfur dioxide, nitrogen oxides and either oxygen or carbon dioxide as outlined in 40 CFR 60.45.

Implementation of the federal emission and ambient air quality standards are the primary responsibility of the states according to the 1970 Clean Air Act. If a state does not exercise regulatory control of air pollution, the United States Environmental Protection Agency (EPA) Administrator is authorized to perform this function. Enforcement of federal emission standards is the responsibility of EPA unless delegated to the states. The NSPS for power plants have been delegated to Iowa, but coal preparation facilities have not.

3. Emission Rates

As discussed earlier in this section, the Federal New Source Performance Standard for sulfur dioxide emissions from coal-fired electric generating stations is 1.2 lb per million Btu (mB) of

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		Primary Standard (ug/m^3)	Secondary Standard (ug/m^3)
1)	Particulate Matter		
	a) Annual Geometric Mean	75	60[a]
	b) Maximum 24hr Concentration[b]	260	150
2)	Sulfur Oxides		
	a) Annual Arithmetic Mean	80 (0.03 ppm)	---
	b) Maximum 24 hr Cocnentration[b]	365 (0.14 ppm)	---
	c) Maximum 3hr Concentration[b]	---	1,300 (0.50 ppm)
3)	Nitrogen Dioxide		
	a) Annual Arithmetic Mean	100 (0.05 ppm)	100 (0.05 ppm)
4)	Carbon Monoxide		
	a) Maximum 8hr Concentration[b]	10,000 (9 ppm)	10,000 (9 ppm)
	b) Maximum 1hr Concentration[b]	40,000 (35 ppm)	40,000 (35 ppm)
5)	Hydrocarbons		
	a) Maximum 3hr Concentration[b] (6 am 9 am)	160 (0.24 ppm)[a]	160 (0.24 ppm)[a]

[a] Guideline only, not a standard. [b] Not to be exceeded more than once per year.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

NATIONAL AMBIENT AIR QUALITY STANDARDS

DATE:

SCALE:

TABLE
IV-C-2

	Coal	Oil	Gas
Particulate Matter			
Emission Rate[a] - lb/mB	0.10	0.10	0.10
Opacity[d] for over 2 min in any hr	20	20	20
Opacity at any time - percent	40	40	40
Sulfur Dioxide			
Emission Rate[a] lb/mB	1.20	0.80	-
Equivalent sulfur content in fuel - percent[b]	0.5	0.7	-
Equivalent concentration in flue gas - ppm[c]	600	400	-
Nitrogen Oxides (as NO_2)			
Emission Rate[a] lb/mB	0.70	0.30	0.20
Equivalent concentration in flue gas - ppm[c]	500	200	150

a/ Emission rates are maximum 2-hr averages.

b/ Based on typical heating values of 9,000 and 18,000 Btu/lb for coal and oil, respectively.

c/ Based on typical flue gas compositions and expressed on a dry volume basis.

d/ A maximum of 40 percent opacity is permissible for not more than 2 minutes in any hour.

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

FEDERAL STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

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SCALE:

TABLE
IV-C-3

heat input. The typical sulfur content of 0.32 percent and the heating value of 9807 Btu per lb of the coal to be burned by Neal Unit 4 will result in an SO2 emission rate of approximately 0.65 lb per mB. At full capacity operation, 3800 lb/hr of SO2 will typically be emitted from the stack. However, the SO2 emission rates and the ground level concentrations presented in this report are based on a sulfur content in the coal of 0.49 percent and a heating value of 8125 Btu per lb of coal which would result in a maximum SO2 emission rate of 1.2 lb/mB. At full capacity operation, a maximum of 7100 lb/hr of SO2 will be emitted from the stack.

Emission rates for oxides of nitrogen are almost completely dependent upon the mode of operation of the Neal Unit 4 furnace. The Neal Unit 4 furnace manufacturer guarantees that under design conditions as discussed in Section II-B-4-b, the unit will meet the Federal New Source Performance Standard of 0.7 lb/mB for oxides of nitrogen. A maximum of 4140 lb/hr of nitrogen oxides will be emitted into the atmosphere at full capacity operation.

Suspended particulate matter emissions will be approximately 0.07 lb/mB for coal based on a maximum 18 percent ash content, and on a 99.6 percent collection efficiency for the electrostatic precipitator. The New Source Performance Standard for particulate matter emission is 0.10 lb/mB. At full capacity operation, a maximum of 420 lb/hr of particulate matter will be emitted.

Ambient pollutant concentrations presented in this report are based on the diffusion calculations using the full load design parameters and maximum values for Neal Unit 4 presented in Table IV-C-4.

4. Ambient Air Quality

The maximum predicted ground level concentrations of all contaminants for Neal Units 1-4 and for Unit 4 alone are discussed below.

a. Sulfur Dioxide Concentrations

The maximum 3-hour average, maximum 24-hour average and annual average ground level sulfur dioxide concentrations calculated for each receptor point due to the continuous full-load operation of Neal Station 4 for the critical year of meteorological record are presented in Table IV-C-5 and compared to the Class II Significant Deterioration Standards. The maximum 3-hour value of 378 ug/m^3 is 54 percent of the 700 ug/m^3 standard. The 24-hour maximum value of 48.63 ug/m^3 is 49 percent of the standard and the annual average concentration of 3.13 ug/m^3 is 1 percent of the standard. These SO2 values for Neal Unit 4 are within the Class II Significant Deterioration Standards.

Parameters	Unit 1	Unit 2	Unit 3	Unit 4
Stack Diameter (ft)	10.2	15.2	19.8	25.8
Stack Height (ft)	250	300	400	469
Sulfur Content (percent)	0.9	0.9	0.9	0.49
Coal Heating Value (Btu/lb)	9000	9000	9000	8125
Particulate Release Rate (lb/hr)	150	410	270	420
SO_2 Release Rate (lb/hr)	2910	6170	10020	7100
NO_x Release Rate (lb/hr as NO_2)	2080	2470	4010	4140
Mass Release Rate (10^6 lb/hr)	1.60	3.33	5.41	6.55
Stack Exit Temperature (F)	300	263	254	244

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

INPUT PARAMETERS FOR DIFFUSION CALCULATIONS
NEAL UNITS 1-4

DATE:

SCALE:

TABLE
IV-C-4

		Neal Units 1-4					Neal Unit 4		
Contaminant	Averaging Time	Maximum	Typical Back-ground	Total Concentra-tion	Minimum Standard*	Percent of Standard	Predicted Concentra-tion (ug/m^3)	Standard** (ug/m^3)	Percent of Standard**
Sulfur Dioxide	3 hr	1,153	0	1,153	1,300	89	378.63	700	54
	24 hr	158	0	158	365	43	48.13	100	49
	Annual	8	0	8	80	10	3	15	1
Nitrogen Dioxide	Annual	6	7	13	100	13			
Particulares	24 hr	8	30	38	150	25	2.88	30	10
	Annual	<1	30	<31	75	41	0.19	10	2
Sulfuric Acid	24 hr	45	2	47	- - -	--			
	Annual	1	2	3	- - -	--			

*National Ambient Air Quality Standards

**Class II Significant Deterioration Standards

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

SUMMARY OF MAXIMUM PREDICTED GROUND LEVEL
CONTAMINANT CONCENTRATIONS
(ug/m^3)

DATE:

SCALE:

TABLE
IV-C-5

The maximum 3-hour average, maximum 24-hour average and annual average ground level sulfur dioxide (SO2) concentrations calculated for each receptor point due to the continuous full-load operation of Neal Station Units 1-4 for the critical year of meteorological record are presented in Table IV-C-5. The maximum 3-hour value of 1,153 micrograms per cubic meter (ug/m³) is 89 percent of the 1,300 ug/m³ 3-hour standard. Less critical are the 24-hour level of 158 ug/m³, 43 percent of the 365 ug/m³ 24-hour standard, and the annual average concentration of 8 ug/m³, which is 10 percent of the 80 ug/m³ annual standard. As discussed previously, background SO2 levels are negligibly low throughout the area of plant air quality impact. Therefore, ambient SO2 concentrations are expected to be within applicable standards.

b. Nitrogen Dioxide Concentrations

The calculated annual average nitrogen dioxide (NO2) concentrations are presented in Table IV-C-5. The maximum value of 6 ug/m³ is 6 percent of the 100 ug/m³ annual standard. After adding the typical background concentration of 7 ug/m³, the total of 13 ug/m³ is 13 percent of the standard.

c. Particulate Concentrations

Table IV-C-5 presents the calculated maximum 24-hour average and annual average particulate concentrations compared to both the ambient and significant deterioration standards. The maximum 24-hour value of 8 ug/m³ is 5 percent of the 150 ug/m³ ambient standard. Adding the typical* background level of 30 ug/m³, the total of 38 ug/m³ is 25 percent of the standard. The maximum annual average is less than 1 ug/m³, which is about 1 percent of the 75 ug/m³ annual standard. Adding the typical background level, the total of 31 ug/m³ is 41 percent of the standard. However, since background concentrations of particulate matter are both high and subject to great fluctuation, the use of only a single typical background level is not sufficient to assess compliance with applicable ambient standards.

Primary ambient air quality standards for total suspended particulates were attained in 1976 in the Sioux City Air Quality Control Region. Since background particulate concentrations in the Neal Station area of impact may be in violation of applicable ambient air quality standards due to the high levels of natural and agricultural dust, the potential incremental effect of the Neal Station on existing contraventions must be considered in more detail. The analysis of this problem, summarized in Table IV-C-6, is discussed below.

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*Measurements of particulate concentrations in the Neal 4 area, when represented using a log-normal frequency distribution, had a median of 30 ug/m³ and a geometric standard deviation of 1.9 corresponding to levels of natural and agricultural dusy typical of rural areas, (see Section III-E-1).

Receptor Description	Downwind Distance	Direction from Station	Annual Wind Frequency	Neal Station Impact	Atmospheric Stability	Plume Width	Background Median	Background Standard Deviation	Critical Background Frequency	Additional Violation Periodicity
Neal Sta. Vicinity	2 km	NNW	11.0%	8 ug/m^3	A or 1	1 sector	30 ug/m^3	1.9	0.16% (sec. std.)	16 yr
Sioux City, Iowa	19 km	N	9.3%	2 ug/m^3	D or 4	1/3 sector	50 ug/m^3	1.8	0.17% (sec. std.)	52 yr
South Sioux City, Neb.	17 km	N	9.3%	2 ug/m^3	D or 4	1/3 sector	130 ug/m^3	1.7	0.24% (pri. std.)	37 yr
									0.96% (sec. std.)	9 yr

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

TWENTY-FOUR HOUR PARTICULATE IMPACT/BACKGROUND JOINT FREQUENCY ANALYSIS

DATE:

SCALE:

TABLE
IV-C-6

It has already been noted that background particulate levels in the Neal Station vicinity may exceed the 150 ug/m³ 24-hour secondary standard about two days yearly. Since the maximum Neal Station impact based on continuous full-load operation is 8 ug/m³, the background concentration at the point of the maximum would need to be in the range of 142 to 150 ug/m³ for the plant's impact to result in an additional violation. From the background particulate frequency distribution, the concentration would be in this range 0.16 percent of the time, or about one day in two years.

The south-southeasterly wind required to carry the Neal Station plumes to the point of the critical concentration occurs with an annual average frequency of 11.0 percent, assuming that the background level and the wind direction are dependent. Therefore, it can be seen that the joint frequency of the background level and the wind direction being critical simultaneously is 0.16 percent x 11.0 percent = 0.0176 percent, or one day in 16 years.

Actually, the frequency of additional secondary standard excesses at any point due to the operation of the Neal Station may be significantly lower, given the infrequency of the large atmospheric instability required to cause the plumes to impact at the critical point.

When considering the above results, it should be emphasized that the large majority of ground level locations within the area of air quality impact are subject to maximum Neal Station 24-hour average particulate concentrations of much less than 8 ug/m³. It should also be noted that because of Unit 4's efficient electrostatic precipitator and tall stack, the Unit 4 contributions are a small fraction of the maximum particulate concentrations attributable to the total plant. For the above reasons, the operation of Unit 4 is not likely to result in additional excesses of ambient particulate standards at any location in the vicinity of the Neal Station.

The considerations described above have also been applied to Sioux City, Iowa and South Sioux City, Nebraska. Since the maximum Neal Station impact is 2 ug/m³ at these locations, the critical range of background concentrations approaching the secondary standard is 148 to 150 ug/m³. Southerly winds, which are required to transport the Neal Station plumes to the locations, are recorded in the Sioux City Airport with an annual average frequency of 9.3 percent. Under the conditions of maximum plant impact (neutral atmospheric stability), the plume width is one-third of a sector. Therefore, the wind actually blows from the Neal Station toward any receptor point to the north with an average frequency of 3.1 percent, or 11 days per year. The results based on this frequency and the background level distributions indicate that an additional secondary standard excess attributable to the combined effects of a high background level and the Neal Station impact may occur one day in

52 years at any ground level location in Sioux City, and one day in 9 years in South Sioux City. Moreover, an additional excess of the 365 ug/m³ primary 24-hour average particulate standard may occur in South Sioux City one day in 37 years.

The steady-state assumption required by the diffusion model (described in Appendix A-IV-C) employed in the Sioux City and South Sioux City analyses lends conservatism to the results, since the critical stability and wind conditions may not persist long enough to transport the Neal Station plumes to the receptor locations. The maximum plant impact of 2 ug/m³ is only about one percent of the applicable standards. Such low levels are below the sensitivity of the high volume sampler, and thus are not directly measurable. Again, since the Unit 4 contribution is a small fraction of the total plant impact, the operation of Unit 4 is not likely to result in additional excesses of ambient particulate standards in the Sioux City-South Sioux City area. With regard to annual average particulate impacts, it should be noted that the total Neal Station annual average impact at South Sioux City was calculated to be only 0.2 ug/m³. This presents a negligible increase of the existing average background level of 130 ug/m³, which exceeds the 75 ug/m³ annual average particulate standard.

d. Sulfuric Acid Concentrations

The calculated maximum 24-hour average and annual average sulfuric acid (H2SO4) concentrations due to the in-plume oxidation of sulfur dioxide are presented in Table IV-C-5. The maximum 24-hour concentration of 45 ug/m³, added to the typical background level of 2 ug/m³, results in a total 24-hour average of 47 ug/m³. The 1 ug/m³ maximum annual value, when combined with the typical background level, results in a total annual average of 3 ug/m³. Because of the very conservative assumptions employed in modelling the formation and transport of H2SO4 (e.g., steady state conditions and conservative reaction rates) these results should be considered as upper limits, not likely to be attained.

Although there are no applicable H2SO4 ambient standards, it may be noted that the threshold limit value for industrial exposures to H2SO4 in 1,000 ug/m³.[2] The most widely employed standard for general populations is a 24-hour average of 100 ug/m³.[3] The maximum concentrations expected in the vicinity of the Neal Station are well within these levels.

5. Effects on Terrestrial Biota

a. Effects on Terrestrial Vegetation

i. Effects of Sulfur Dioxide on Terrestrial Vegetation

Sulfur is an essential plant macronutrient and required in relatively large amounts. Sulfur dioxide (SO2) which is taken up by plants through leaf stomata[4] may be a source of sulfur for the synthesis of sulfur-containing compounds. Although the source of sulfur is generally sulfate (SO4) obtained by root absorption from soil, foliar uptake of gaseous SO2 has proven, under laboratory conditions, to be an alternative source[5]. Agricultural soils may require, for maximum productivity, addition of sulfur-containing fertilizers, if SO4 in precipitation and soil absorption of SO2 are insufficient to compensate for depletion incurred by crop removal[6].

The sensitivity to SO2 of woody plants and important agricultural species of the George Neal area are indicated in Table IV-C-7. Few plants other than economically important ones have been investigated for sensitivity to SO2.

Concentrations of SO2 predicted from operation of George Neal Units 1-4 are presented in Section IV-C-4 and summarized in Table IV-C-5. The maximum (including background level) predicted ground level 3-hour, 24-hour and annual concentrations of SO2 are 1153 ug/m^3, 158 ug/m^3, and 8 ug/m^3, respectively.

The maximum annual average SO2 concentration predicted for George Neal Units 1-4, 8 ug/m^3, is less than the 13 ug/m^3 concentration reported to affect lichen species, which are particularly sensitive to atmospheric pollutants. Although the effects of chronic exposure to low concentrations of SO2 are not generally known, it appears unlikely that the predicted maximum annual concentration from George Neal Units 1-4 will injure flora of the site and surrounding region.

The predicted maximum 3-hour concentration of SO2 exceeds the suggested injury thresholds for sensitive plant species. If conditions conducive to plant injury occur concurrently with SO2 concentrations exceeding the suggested injury threshold levels, sensitive species may suffer visible injury. The effects of possible foliar injury on yields of known sensitive species occurring in the site region, alfalfa, soybeans, and grains, depend on numerous factors and cannot accurately be predicted.

The presence of other pollutants in addition to SO2, such as NO2 or O3, could alter the levels at which SO2 affects plants. Available information on plant responses to mixtures of air pollutants is not adequately complete to determine of thresholds applicable to field situations involving SO2 and other gaseous pollutants.

A. Woody Plants

Species	Sensitivity[a]		
	Tolerant	Intermediate	Sensitive
Juniper (Juniperus spp.)	X		
Jack pine (Pinus banksiana)			X
Austrain Pine (Pinus nigra)	X		
Eastern white pine (Pinus strobus)			X
Red maple (Acer rubrum)	X		
Boxelder (Acer negundo)	X	X	
Sugar maple (Acer saccharum)	X		
Silver' maple (Acer saccharinum)	X		
Birch (Betual spp)			X
White birch (Betula papyrifera)			X
Flowering dogwood (Cornus florida)	X		
Green ash (Fraxinus pennsylvanica)	X		
Tulip tree (Liriodendron tulipifera)	X		
Apple (Malus spp.)			X
Sycamore (Platanus occidentalis)			

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

SENSITIVITIES TO SULFUR DIOXIDE OF WOODY AND AGRICULTURAL PLANTS COMMON TO THE PORT NEAL AREA

(SHEET 1 OF 3)

DATE: SCALE:

TABLE IV-C-7

Species	Sensitivity[a]		
	Tolerant	Intermediate	Sensitive
Eastern cottonwood (Populus deltoides)	X		
Pear (Pyrus spp.)			X
Red oak (Quercus rubra)	X		
Black locust (Robinia pseudo-acacia)	X		
Willow (Salix spp.)			X
American elm (Ulmus americana)			X
Basswood (Tilia americana)		X	
Mulberry (Morus spp.)			X
Sumac (Rhus spp.)		X	
Honeysuckle (Lonicera spp.)		X	
Wild grape (Vitis spp.)			X
B. Agricultural Crops			
Soybeans (Glycine max)			X
Alfalfa (Medicago sativa)			X
Potato (Solanum tuberosum	X	X	
Corn (Zea mays)	X		
Wheat (Triticum aestivum)			X

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

SENSITIVITIES TO SULFUR DIOXIDE OF WOODY AND AGRICULTURAL PLANTS COMMON TO THE PORT NEAL AREA

(SHEET 2 OF 3)

DATE: SCALE:

TABLE
IV-C-7
(Cont'd)

Species	Sensitivity[a]		
	Tolerant	Intermediate	Sensitive
Rye (Secale cereale)			X
Oats (Avena sativa)			X
Red clover (Trifolium sativum)			X

a. Compiled from references 11, 24, 25.

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

SENSITIVITIES TO SULFUR DIOXIDE OF WOODY AND AGRICULTURAL PLANTS COMMON TO THE PORT NEAL AREA

(SHEET 3 OF 3)

DATE: SCALE:

TABLE
IV-C-7
(Cont'd)

ii. Effects of Acid Rain and Sulfate Deposition on Vegetation

Acid rain may result from the oxidation of SO2 and NO2 to sulfuric (H2SO4), sulfurous (H2SO3) and nitric (HNO3) acids. Rain with pH values as low as 2.1 has been measured during the past 20 years in samples collected in New Hampshire. These decreases in pH have been tentatively attributed to coal combustion and consequent increases of concentrations of these acids in precipitation[26]. The extent to which stack releases from coal combustion promote acid precipitation is currently debated[27].

Sulfate deposition may affect terrestrial systems by lowering the pH of rain and soil; the impact of SO4 deposition is therefore discussed in terms of potential impact of acid rain. Although high concentrations of SO4 have been associated with leaf chlorosis[8] and inhibition of uptake of calcium and molybdenum,[28] these effects have apparently not been attributed to the deposition levels resulting from operation of power plants. Deposition rates of sulfate (and soil absorption of SO2) derived from coal combustion are small, even in heavily impacted areas, when compared to amounts of SO4 added to croplands to offset sulfur losses by harvesting of crops[29].

Likens and Bormann[26] state that "the ecological effects of acid rain are as yet largely unknown, but potentially they are manifold and very complex." They note that possible consequences of acid rain may include changes in leaching rates of nutrients from plant foliage and soil, and long-term decreases in forest productivity. Reuss[29] concluded that acid rain leaching of nutrients from soil in moderately to heavily impacted areas "would be of little consequence in agricultural areas where nutrients are commonly replaced, but may well be significant in forests and areas not intensively farmed."

Present literature suggests that coal combustion may lower the pH of rain within local or large regional areas. It appears unlikely that possible decreases of rain pH resulting from Units 1-4 will affect agricultural systems. The extent, if any, of rain pH change, and its potential effect on forest vegetation and soils cannot be determined due to the present state-of-the-art.

iii. Effects of Nitrogen Dioxide on Vegetation

High concentrations of NO2 may cause plant injury. Symptoms of acute injury are similar to those resulting from excessive dosages of SO2 described in the preceding section. Chronic injury induced by NO2 is characterized by discolored flecks on leaf surfaces, and premature leaf abscission[4]. Plant responses to NO2 vary with species, lengths of exposure, developmental stage of the plant, and environmental conditions such as soil moisture and light intensity[35].

Concentrations of NO2 which produce visible plant injury are high, relative to ambient levels near fossil-fuel power plants. Thompson et al[33] suggested the following threshold levels of NO2 for visible injury: 18,800-2,200 ug/m^3 for 1 hour, 4324 - 6580 ug/m^3 for 8 to 21 hours, and 1800 ug/m^3 for 48 hours. Limited data suggest that plants exposed to NO2 for intervals longer than 48 hours may be affected by lower concentrations. For example, the yield of navel oranges decreased, and leaf drop increased, following an 8 month exposure to 470 ug/m^3 NO2.[36]

Reductions in rates of photosynthesis may result from short-term exposures to low concentrations of NO2. Hill and Bennett[37] observed a reduction in uptake of CO2 in oats and alfalfa exposed for 0.75 to 1.5 hours to 940 - 1316 ug/m^3 NO2. They doubt that significant growth reductions would occur from inhibition of CO2 uptake, however, without foliar damage[12]. Their data and that of others indicate that "plants can repeatedly recover from subnecrotic exposures to SO2, Cl2, NO2, and NO if sufficient time is allowed between fumigation for full recuperation. Generally an intervening nighttime period is sufficient."

Plant injury caused by NO2 can be increased by simultaneous exposure to SO2. A discussion of this effect is included in the preceding section.

Maximum concentrations of NO2 predicted from operation of Units 1-4 are presented in Section IV-C-4. The predicted maximum ground level 1 hour, 4 hour, and annual averages are 2315 ug/m^3, 816 ug/m^3, and 13 ug/m^3, respectively. The predicted 1 and 4 hour maximum concentrations of NO2 were calculated using the methodology discussed in Section IV-C-1. Concentrations are considerably less than the NO2 levels suggested as potentially injurious to vegetation, and are not expected to significantly affect plants of the site and surrounding region.

Plant responses to mixtures of NO2 and SO2 are discussed in the section which assesses the effects on vegetation of SO2.

iv. Effects of Particulate Matter on Vegetation

Information reported in the literature on the effects of particulates on vegetation is limited, and precludes a complete assessment of impact. Investigations of effects of particulates on conifers growing near a power plant in West Virginia are inconclusive, and are not considered applicable to situations where fly-ash removal systems are operating properly. The lack of information on fly-ash injury to vegetation suggests that particulate emissions from power plants with properly operating fly-ash removal systems are not likely to injure vegetation.

b. Effects on Terrestrial Wildlife

Sulfur dioxide, nitrogen dioxide, and particulate matter may adversely affect animals. These effects depend upon many factors, including the sensitivity of a given species to specific emissions, period of exposure and physiological conditions of exposed organisms. In addition, emissions may indirectly influence animals by affecting the quality of vegetation upon which they depend for food and cover.

i. Effects of Sulfur Dioxide on Wildlife

Animals exposed in the laboratory to high concentrations of SO2 show upper respiratory tract and ocular irritation and bronchoconstriction[43]. The physiological and pathological responses of animals to SO2 are shown in Table IV-C-8. Most of these studies have used concentrations of SO2 higher than those predicted for the area within 25 km of the proposed station.

The maximum predicted three-hour, 24-hour and annual concentrations of SO2 (including background) within 25 km of the proposed facility are 1153, 158, and 8 ug/m^3, respectively (Table IV-C-5). The maximum predicted three-hour level of SO2 (1153 ug/m^3) lies within the range of concentrations at which adverse effects on laboratory test animals have been noted. Amdur and Underhill[44] found temporary increases in pulmonary flow resistance of guinea pigs (sensitive to SO2) to 460 and 1310 ug SO2/m^3. However, other investigations, reviewed and synopsized by Talisayon[43] have shown guinea pig pulmonary function and blood chemistry to be unaffected by year long exposures to SO2 concentrations of 240 to 15.0 x 10^3 ug/m^3. Overall, present knowledge of the effects of low SO2 concentrations on animals is not well documented, and"... the presence or absence of adverse effects of ambient levels of the order of 0.1 ppm (260 ug SO2/m^3) is, experimentally, still an open question"[43].

The effects of both chronic and acute concentrations of SO2 from Neal Units 1-4 on local wildlife species cannot be predicted adequately with the data presently available. However, the information presented in Table IV-C-8 suggests adverse effects on wildlife from SO2 emissions are unlikely.

ii. Effects of Sulfuric Acid Mist on Wildlife

SO2 from the Units 1-4 stacks will undergo atmospheric oxidation to sulfate (SO4). A fraction of the SO4 formed may exist as sulfuric acid mist (H2SO4). Sulfuric acid mist has been shown to be more toxic than SO2 in experiments with laboratory animals[45]. The predicted maximum 24-hour and annual average ground level concentrations of sulfates (taken complete as H2SO4) from Unit 1-4 are 45 and 3 ug/m^3, respectively (Table IV-C-7). Concentrations of H2SO4 for these two exposure periods are considerably lower than those tolerated by laboratory animals and

Stack Emission	Concentration (ug/m³)	Length of Exposure	Animal Tested	Effect Or Response	Reference
SO_2	370×10^3	154 hrs	Guinea Pigs	LC 50-50 Percent Mortality	(55)
SO_2	393×10^3	847 hrs	Mice, Cockroaches, Grasshoppers	LC 50-Mice (Insects - Similar to Mice)	(55)
SO_2	460 and 1310	1 hr	Guinea Pigs	Temporary increase in pulmonary flow resistance	(46)
SO_2	79, 445, 17.8×10^3	165 days	Rats	Depression of red cholinesterase, spleen dehydrase, carbohydrase, and Vitamin C concentrations in certain organs	(43)
SO_2	340, 2650, 15.0×10^3	1 yr	Guinea Pigs	No significant differences in pulmonary function or clinical biochemical tests	(43)
SO_2	1405-7673	14 wks	Honey Bees	Hives gained less weight, produced less surplus honey, collected less pollen, and produced smaller broods	(47)
SO_2	2.55×10^6		Honey Bees	LC 50 for adults, larvae, eggs, pupae were 25, 71, 147, and 1725 minutes, respectively	(47)
NO_2	165×10^3	240 min.	Rats	LC 50	(48)
NO_2	900 1900	4 hr 1 hr	Rats Rats	Degranulation in mast cell morphology of lung Degranulation in mast cell morphology of lung	(48)
NO_2	940	6-24 hr/day for 12 mos.	Mice	Enlargement of alveoli of lung; enhanced susceptibility to respiratory infection as demonstrated by increased mortality after exposure to bacteria (*Klebsiella pneumoniae*)	(48)
NO_2	470	4 hr/day for 6 days	Rabbits	Structural changes in lung collagen and elastin; condition reversible but some damage persisted after 7 days.	(48)
NO_2	1500	Continuous, Lifetime	Rats	Tachypnea and some terminal bronchiolar hypertrophy	(48)
NO_2	28.2×10^3	Continuous, 1 yr	Guinea Pigs	Formation of circulating substance in lung - possibly lung antibody	(48)

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

TOXICOLOGICAL EFFECTS OF SO_2, NO_2 ON TEST ANIMALS

DATE: SCALE:

TABLE
IV-C-8

therefore, are not expected to be harmful to wildlife in the vicinity of Units 1-4.

iii. Effects of Nitrogen Dioxide on Wildlife

Nitrogen dioxide exerts its primary toxic effect on the lungs of animals. The maximum one hour, four hour and annual concentrations of NO2 (including background levels) from George Neal Units 1-4 have been predicted at 2315, 816 and 13 ug NO2/m^3, respectively. The one and four hour concentrations of NO2 were calculated using the methodology presented in Section IV-C-1 of this document, and the predicted annual concentration is found in Table IV-C-5.

The predicted one and four hour NO2 levels are in the range of concentrations which have been shown, experimentally, to produce subtle changes in lung metabolism (e.g., lipid peroxidation in rat lungs and alteration of lung collagen and elastin) and lung pathology (e.g., degranulation of mast cells in rat lungs)[48]. However, most symptoms appear to be reversible after short-term exposures to concentrations below 1900 ug NO2/m^3 [48]. Although the reaction of wildlife species to various levels of NO2 has not been ascertained, laboratory experiments suggest that potential minor and reversible lung damage to mammals may occur during those periods of elevated NO2 concentrations.

The predicted annual concentration of NO2, 13 ug/m^3, is two to three orders of magnitude below concentrations which, during continuous lifetime and/or one year exposures, have affected rats and guinea pigs respectively (Table IV-C-8). No experimental data suggest that concentrations of 13 ug NO2/m^3 will adversely affect wildlife in the George Neal Plant vicinity.

iv. Effects of Particulate Emissions on Wildlife

Particulate emissions consist of heterogeneous and variable mixtures of airborne solids. Ingestion of vegetation contaminated by particulates containing toxic chemical components may be detrimental to animal health. Detailed assessment of the impact of the predicted concentrations of particulate matter on wildlife cannot be made because of the paucity of the available data.

The maximum predicted 24-hour and annual concentrations of particulate matter within 15 km of the proposed facility will be 38 and 30 ug/m^3, respectively (Table IV-C-5). The National Secondary Standards for particulate matter are 150 and 60 ug/m^3, respectively. The maximum 24-hour and annual concentrations are not to be exceeded more than once per year. Since the predicted particulate matter levels of the proposed facility are below standards which are designed to protect and conserve natural resources and environment, no adverse effects on wildlife near the site are expected.

v. Stack Interference

The stack of Unit 4 will be 469 feet high and about 26 feet in diameter at its top. It will intrude into the airspace and has a potential to obstruct the flight of birds, especially nocturnal migrants. Tall structures, such as the Washington Monument and television towers, have been noted as obstructions to migrating birds[56]. More recently, cooling towers and stacks associated with generating stations have been reported as obstructions to birds[57,58,59].

Neal Unit 4 is situated in the Missouri River Valley, a major avian flyway during fall and spring migration[62]. A study of nocturnal bird migration conducted in Illinois has shown that approximately 20 percent of the migrants fly below an altitude of 500 feet[63]. It is expected that bird mortality will be greater in the fall than spring, owing to the large number of young birds making their first migration. Small passerines will probably be most susceptible to collision particularly during inclement weather when a low cloud ceiling forces birds to fly at low altitudes.

Based on the above discussion and reports of bird mortality at structures of similar height,[57,58,59] there may be a potential for bird collision with the stack at Unit 4. It is difficult to accurately estimate the extent of bird mortality because 1) mortality studies at similar structures in the region are presently not available, 2) bird densities and migration flight height past the site are not known, and 3) the state-of-the-art in predicting mortality under various meteorological conditions is not adequate at present. However, the narrow dimensions of the stack may preclude any significant affects on bird populations.

D. IMPACT OF SANITARY WASTE SYSTEM

There will be no discharge of sanitary wastes to the Missouri River. The treated effluent from the extended aeration activated sludge treatment system will be discharged to a leaching field and will not be monitored. The characteristics of the treated wastewater are expected to be as follows:

Flow	3500 GPD
Suspended Solids	15-25 mg/l
BOD	15-25 mg/l
Phosphorus	10-15 mg/l as P
Total Nitrogen	20-30 mg/1 as N
Total Dissolved Solids	500 mg/l

The sanitary wastes will have no detectable effect on groundwater quality.

E. IMPACT OF CHEMICAL DISCHARGES

All discharges from the chemical waste and coal pile runoff collection and treatment system, described in Section II-B, will be in compliance with all applicable Iowa, Nebraksa and federal regulations. As discussed in Section II-B, no chemical additions will be made to the once-through main condenser cooling water. In addition, during normal plant operations no water will be discharged from any ash handling operation: the fly ash system will be pneumatic, the bottom and economizer ash systems will employ complete recycling of all sluice water.

The following estimate of water quality in the discharge is based on average water quality in the Missouri River and normal plant operation:

Parameter	Mean	Range
pH	8.0	6.0-9.0
TDS (mg/l)	3000.	1000-4000
Alkalinity (mg/l)	65.	50-150
Total Hardness (mg/l)	550	300-600
TSS (mg/l)	25	10-50
Oil & Grease (mg/l)	≤10	≤10-25
Total Iron (mg/l)	≤0.2	≤0.2-0.5
Total Copper (mg/l)	≤0.2	≤0.2-0.5
Flow (CFS)	0.73	0.1-1.5

Based on the above estimates there will be no measurable effect on the water quality in the Missouri River resulting from the discharge of effluents from the chemical treatment system.

Coal Pile Runoff

The quality of treated coal pile runoff will be as follows:

Parameter	Range
pH	6.0-9.0
TSS	less than 50 mg/l
TDS	less than 500 mg/l
Alkalinity	less than 100 mg/l
Sulphate	less than 50 mg/l
Total Hardness	less than 100 mg/l

Coal pile runoff will be associated only with storm events.

Potential Leaching

There is a potential impact by the seepage of leachate from ash ponds. This leachate may contain trace substances which can contaminate ground water and adjacent wetlands. Self-sealing capacity of the ash pond will be studied. Analyses of the existing ash pond (Neal Unit 3) constituents will be used to determine the need or lack of need for pond lining.

F. IMPACT ON LAND USE, RECREATIONAL SITES AND AESTHETICS

1. Land Use and Overall Regional Character

The facilities of the proposed project will be located south of the existing Neal Units 1-3. The proposed project's coal storage area will be located in the middle portion of the site and the disposal area will cover the eastern portion. The plant structure will be situated in the western portion of the tract. A spur from the rail line used for the existing George Neal Station will service the site and connect it with the remainder of the region.

Existing land use in the region is primarily agricultural and agriculturally related. Agricultural production within the four county area of Woodbury and Monona Counties, Iowa, and Dakota and Thurston Counties, Nebraska accounts for approximately 90 percent of the total land use of the Sioux City region. Land devoted to agricultural production in the immediate vicinity of the site accounts for 76 percent of total land use. The remaining areas include forest, grassland, marsh, and vacant land. Developed areas in the vicinity of the proposed plant are predominantly industrial. Of major importance is the Port Neal Industrial District which encompasses nearly 3000 acres of industrial land south of the Sioux City Airport. The proposed Neal Unit 4 is at the southern extension of this District. A central component of the industrial complex is the existing George Neal Steam Electric Station.

According to the Woodbury County Planning and Zoning Office, the Iowa State Office of Planning and Programming and the Siouxland Interstate Metropolitan Planning Council, there are no comprehensive projects or plans at present for the Neal Unit 4 area other than those now under consideration. There are no public services (water and sewer) planned in the area in the foreseeable future.

The proposed Neal Unit 4 site is situated in a generally sparsely populated area. Across the Missouri River from the proposed site, in Nebraska, there are no nearby population concentrations or centers. Roads are present to the north and east of the proposed site, but on-site project roads must be developed which tie into the existing system.

The proposed 345 kV transmission line is not expected to adversely impact land use since the right-of-way crosses predominately agricultural lands and will not interfere with cultivation.No known historic sites, archeologic sites or game management areas will be adversely impacted by the transmission facilities. Minimum impact on wildlife is expected because line construction will alter little wildlife habitat.

The easement area will consist of approximately 423 acres of real estate. Approximately 18 acres of the total 423 acres consist of scattered tree growth. It is estimated that 6 acres of the total 18 acres of tree growth will have to be removed for the safe operation of the transmission line. Approximately 405 acres of the total 423 acres consist of open land (cultivated land and pasture or hay land). It is estimated that approximately 2.2 acres of the total 405 acres will be taken out of production due to transmission line structure ground encroachments.

In summary, the proposed plant site is situated in an industrially zoned area in a generally agricultural region, adjacent to an array of industrial facilities located to the north. Since a power generating station and its attendant ash handling, coal handling, and related activities already exists within the industrial district, the addition of Neal Unit 4 is not considered to be in conflict with present land use patterns.

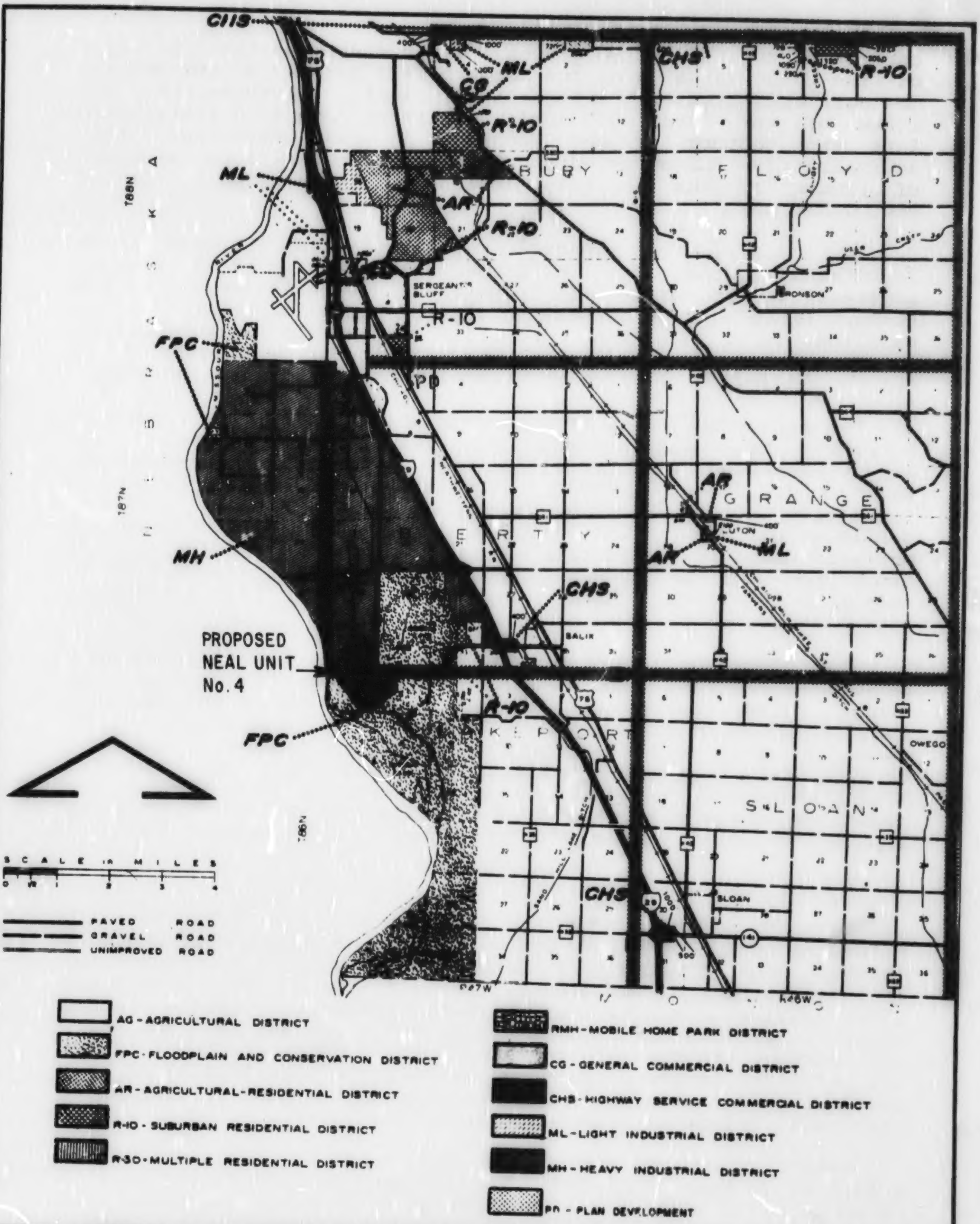
The impact of Neal Unit 4 becomes more complex when viewed in respect to anticipated, or future, land use. The Snyder-Winnebago Bends Recreation Area (proposed for development by the U.S. Army Corps of Engineers) could be a major public recreation facility in the vicinity of Neal Unit 4. When completed, the park will extend along approximately seven and one-half miles of the Missouri River south of Neal Unit 4. In order to avoid possible negative visual impact here, it will be necessary to maintain proper coordination with the developing organizations of the proposed recreation areas.

The plant building, disposal area, and coal facilities will be visible for some distance, due to the flat terrain of the area. Zones from which the proposed site is highly visible include: portions of Interstate Highway 29, several minor 2-lane roads on both sides of the Missouri River, several existing housing units scattered throughout the area, and the proposed Synder-Winnebago Recreation Area. In order to contribute to the reduction of visibility of various facilities of Neal Unit 4, implementation of landscaping techniques will be carried out.

2. Zoning

The site of the proposed project occupies an area entirely within a "MH" or heavy industrial zoning district of Woodbury County. The "Zoning and Subdivision Ordinances for the Unincorporated Area of Woodbury County," adopted January 1971 and since revised, states that the heavy industrial district is the least restrictive district of any district and may be used "for any purpose whatsoever", provided certain designated regulations are met. The proposed project is not in conflict with the provisions mandated for the district and is in general compliance concerning permitted uses, (See Appendix A-IV-F).

Woodbury County zoning in the area of Neal Unit 4 is presented in Exhibit IV-F-1. The southern portion of the site is shown as being situated in the "FPC District', or floodplain and


ML
CG
R-10
R-10
ML
AR
R-10
SERGEANT'S BLUFF
R-10
FPC
PD
F L O Y D
G R A N G E
AR
LUTON
ML
AR
MH
CHS
SALIX
PROPOSED
NEAL UNIT
No. 4
FPC
R-10
OWEGO
S L O A N
BRONSON
CHS
SLOAN
T88N
T87N
T86N
R47W
R46W
SCALE IN MILES
0 1/2 1 2 3 4
PAVED ROAD
GRAVEL ROAD
UNIMPROVED ROAD
AG - AGRICULTURAL DISTRICT
FPC - FLOODPLAIN AND CONSERVATION DISTRICT
AR - AGRICULTURAL-RESIDENTIAL DISTRICT
R-10 - SUBURBAN RESIDENTIAL DISTRICT
R-30 - MULTIPLE RESIDENTIAL DISTRICT
RMH - MOBILE HOME PARK DISTRICT
CG - GENERAL COMMERCIAL DISTRICT
CHS - HIGHWAY SERVICE COMMERCIAL DISTRICT
ML - LIGHT INDUSTRIAL DISTRICT
MH - HEAVY INDUSTRIAL DISTRICT
PD - PLAN DEVELOPMENT

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

WOODBURY COUNTY ZONING IN THE
AREA OF NEAL UNIT 4

EXHIBIT
IV-F-1

DATE:
SCALE:

conservation district. This area has been rezoned, however, to industrial since map publication.

3. Visual Impact, Landscaping, and Horticultural Practices

The potential visual impact of Neal Unit 4 concerns exposure of the plant buildings, stacks, disposal area and coal area.

In providing for the restoration and enhancement through landscape treatment of the proposed project, two areas of primary concern have been recognized. One, the high visibility of various components of the proposed project from nearby properties, roads, and proposed recreational facilities. Second, the restoration and landscape treatment of the proposed site to blend facilities into the existing environment and enhance the visual setting.

In areas where considerable excavation and earth movement occur during construction, landscaping techniques will be employed to return the site to appropriate gradient and preconstruction features. Planting will be used to complete the restoration process, to provide screening in certain areas, and to help relate the station structures to the visual environment. Ornamental trees, shrubs, grasses, and other ground cover will be applied as required in the immediate vicinity of the plant area. More than 31,000 native and ornamental trees and shrubs have been planted on the perimeter of the plant site area to act as barriers and screening in order to eliminate or mitigate views of objectionable areas. The use of ornamental and native plant materials will also help to establish stable conditions and control any potential erosion, especially along the east bank of the Missouri River.

4. Fuel Supply

a. Mine Area

The primary source of coal for Neal Unit 4 will be the Red Rim area of Sweetwater and Carbon Counties in Wyoming. A letter of intent has been signed with the Rocky Mountain Energy Company, a subsidiary of Union Pacific Corporation, to develop a plant for a joint mining venture with the Energy Development Company, a subsidiary of Iowa Public Service Company. Negotiations for a formal agreement are in progress.

An alternative source of coal for Neal Unit 4 could be from mines in the Hanna, Wyoming area. Three mines in this area are currently under long-term contracts to supply fuel for Neal Units 1-3. Since the Neal Unit 4 boiler will have the capability to burn coal with a wide variation in characteristics, the potential for supplying Neal Unit 4 from mines in the Hanna area, or subsequently from mines in other areas, could be investigated should difficulties arise in the negotiations for the Red River area.

The Energy Development Company, which will operate the Neal 4 mine, has implemented operational procedures involving the leveling of stripped areas and replacement of topsoil followed by reseeding of all areas with local grasses.

Both regional and site specific environmental and socioeconomic studies for the mine areas have been completed or are underway. In all cases, the mining operations would comply with all existing regulations such as those set forth by the State of Wyoming, U.S. Bureau of Land Management (43 CFR 3041), U.S. Geological Survey (30 CFR 211) and the U.S. Environmental Protection Agency (40 CFR 434).

b. Fuel Delivery

The coal will move by unit train on the Union Pacific Railroad which presently goes through the area. The Chicago Northwestern Railroad will take the unit trains from the Union Pacific Railroad at Council Bluffs, Iowa or Fremont, Nebraska and deliver them to the Neal Unit 4 site. Since these are already existing and active rail routes, except for the constructed spur to the site, no impact on land use or changes in regional character are expected.

G. NOISE IMPACTS

1. Introduction

Daytime ambient sound measurements at the Neal Unit 4 site were taken on March 18, 1975. These measurements were taken prior to any construction activities at the site and reveal a residual sound level (approximating L90) of 42 dB(A).

The following instruments were used during the sound survey: one (1) precision sound level meter and analyzer, General Radio Company Type 1933 (ANSI - Type 1), Serial No. 620 with electret condenser microphone Type 1962-9601, Serial No. 1367. This instrument was calibrated just prior to and immediately after taking sound measurements with a sound level calibrator, General Radio Company, Type 1562-A, Serial No. 8710. A microphone windscreen was used to reduce wind effects.

The impact of plant construction activities, operation and maintenance and transmission facilities on the existing environments at the Neal Unit 4 site is discussed in detail below.

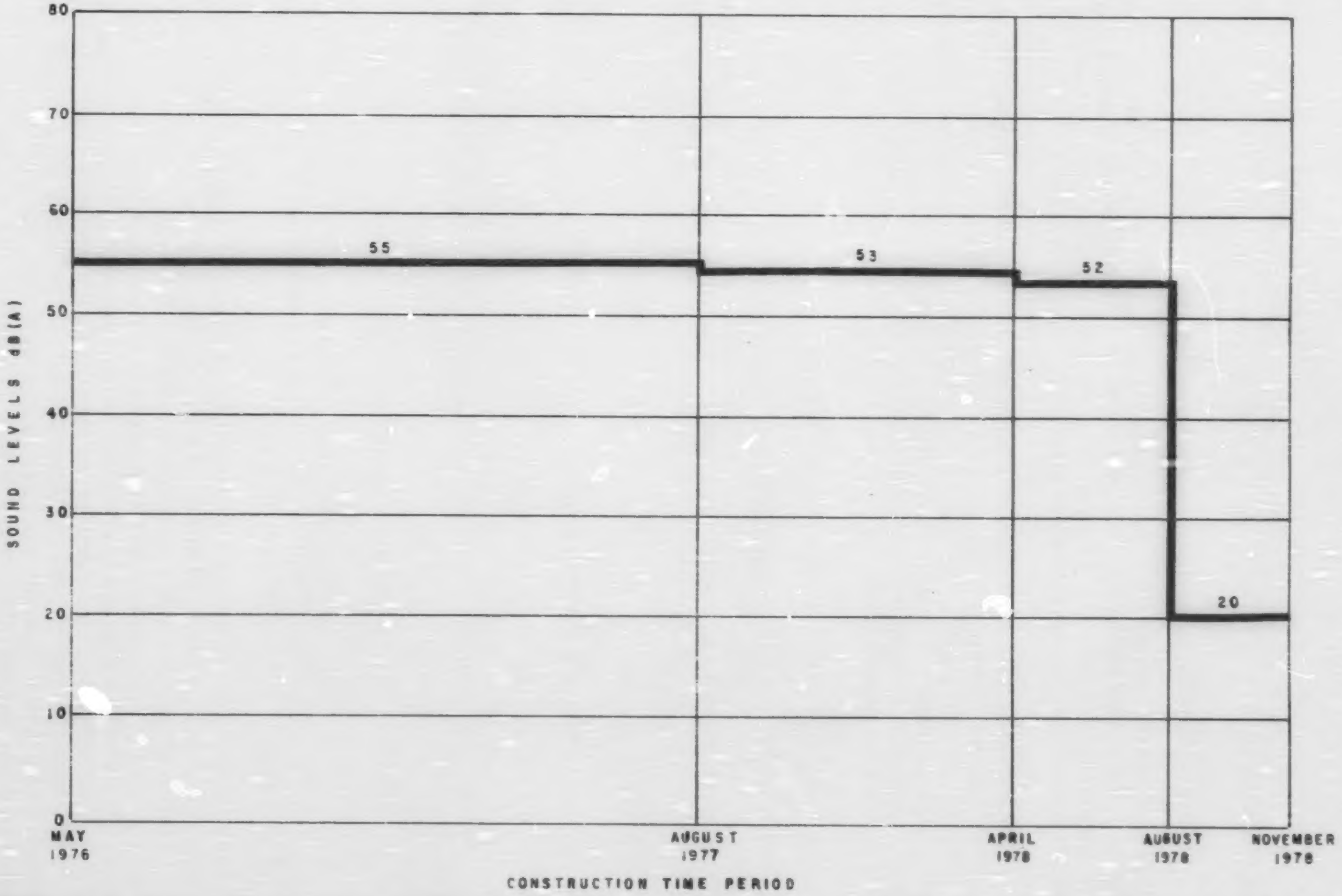
2. Plant Construction

a. Noise Characterization

At Neal Unit 4 the construction activities will last through November 1978 and are being carried out in the following discrete stages, each of which has its own characteristic mix of equipment:

- Site clearing and grading
- Excavations
- Foundations and concrete pours
- Structural steel and siding erection
- Equipment installation

The work done during any one stage is often concurrent with that of one or more other stages, such as work done on the siding erection and simultaneous equipment installation. Table IV-G-1 depicts major noise sources during plant construction and their correspondent average sound levels, and Exhibit IV-G-1 shows the sound level produced by the construction activities at the nearest residence (4900 ft). As can be seen from this Exhibit, the construction site noise output changes as work progresses from a maximum value of 55 dB(A) to a level of 20 dB(A) by August 1978.



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IOWA PUBLIC SERVICE COMPANY — GEORGE NEAL UNIT 4

CONSTRUCTION SOUND LEVELS AT A DISTANCE OF ABOUT 4900 FT FROM THE PLANT CONSTRUCTION CENTER

DATE:

SCALE:

EXHIBIT
IV-G-1

Equipment	Average Sound Level (db(A))	Distance From Equipment (ft)
Truck Cranes	83	50
Mobile Cranes (Cherry Pickers)	83	50
Backhoes	85	50
Graders	85	50
Air Compressors	81	50
Pickup Trucks	58	50
Trucks	91	50
Bulldozers	80	50
Front End Loaders	79	50
Scrapers	88	50
Crane Derrick	88	50
Crawler Cranes	83	50
Pile Driver	104 dB Peak Impact	50
Steam Blowout	129	50

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

MAJOR NOISE SOURCES
DURING PLANT CONSTRUCTION

TABLE
IV-G-1

DATE: SCALE:

At the Neal site, the normal construction workday is based on a single shift, 8 hour day, 40 hour week, Monday through Friday. However, extended workdays might be required as work progresses.

Table IV-G-2 shows an equipment utilization schedule that indicates the type, quantity and operational period of the equipment utilized during plant construction (between May 1976 and December 1978). There will also be construction work done in connection with the holding pond dike and Table IV-G-2 depicts the type and quantity of equipment associated with this work.

At the end of construction and prior to Neal Unit 4 trial operation there will be noise produced by the steam blowout, which is a temporary procedure that cleans the debris left in the steam pipework. At Neal Unit 4, the steam blowout operation will use silencers that will reduce the noise output during this process.

Sound level estimates for individual pieces of equipment shown in Table IV-G-1 were used in conjunction with the plant and dike equipment utilization schedule shown in Table IV-G-2 to develop the temporal construction sound output at the Neal Unit 4 site. The sound level associated with each period was computed by estimating the sound pressure level produced by individual pieces of equipment at a distance of 50 feet. These levels were added logarithmically and represent the sound produced by the construction activities at any given period of time. Exhibit IV-G-1 depicts graphically the estimated sound levels projected at a distance of about 4900 ft (nearest residence), and demonstrates the temporal characteristics of the station construction activities.

b. Plant Construction Noise Impact

The representative maximum sound level of the entire construction period was projected in 5 dB(A) intervals using hemispherical spreading and molecular absorption as shown in Exhibits IV-G-2 and 3. Two acoustic centers were selected for the propagation model: one near the power station boiler where most of the construction activities are assumed to be centered, and a second one in the center of the holding pond to represent the dike construction. The dashed contours shown in Exhibit IV-G-3 depict the sound levels produced by the construction activities carried out in connection with the aforementioned dike.

As can be seen from Exhibit IV-G-1 the maximum sound level produced by the station construction activities at a distance of about 4900 ft. varies between 55 dB(A) and 20 dB(A) during the construction period (May 1976 through November 1978). Between May 1976 and August 1978 the sound level ranges between 52 and 55 dB(A), and between August 1978 and November 1978 there is a constant level of 20 dB(A).

PLANT CONSTRUCTION EQUIPMENT SCHEDULE

1 - Manitowoc 4100 Crawler Crane - May 1976 to July 1978
1 - Manitowoc 4100 Crawler Crane - May 1976 to June 1978
2 - Manitowoc 4000 Crawler Crane - May 1976 to May 1978
1 - Manitowoc 3900 Crawler Crane - May 1976 to December 1977
1 - Manitowoc 3900 Crawler Crane - July 1976 to April 1978
1 - Koehering 65T Crawler Crane - May 1976 to September 1978
1 - American 65T Truck Crane - May 1976 to September 1978
1 - Linkbelt 65T Truck Crane - May 1976 to September 1978
1 - Linkbelt 50T Truck Crane - May 1976 to September 1978
1 - 65T Truck Crane - - July 1976 to July 1977
1 - 75T Stiffleg Derrick - - June 1976 to August 1977
10 - 14T Cherry Pickers - - May 1976 to September 1978
1 - 600 CFM Compressor - - May 1976 to September 1978
1 - Front End Loader - - May 1976 to September 1978
1 - Backhoe - - May 1976 to December 1977
1 - Backhoe - - May 1976 to June 1976
1 - Loader - - May 1976 to September 1976
8 - 3/4T Pickups - - May 1976 to December 1978
4 - 10T Dump Trucks - - May 1976 to September 1977
1 - Pile Driving Rig - - May 1976 to August 1976
3 - 2-1/2 2T Flat Bed Trucks - May 1976 to September 1978
1 - Grader - - May 1976 to September 1978

DIKE CONSTRUCTION EQUIPMENT SCHEDULE

4 - 14 cu. yd. scrapers - August 1976 to October 1978
2 - D-8 Dozers - August 1976 to October 1978
1 - Grader - August 1976 to October 1978

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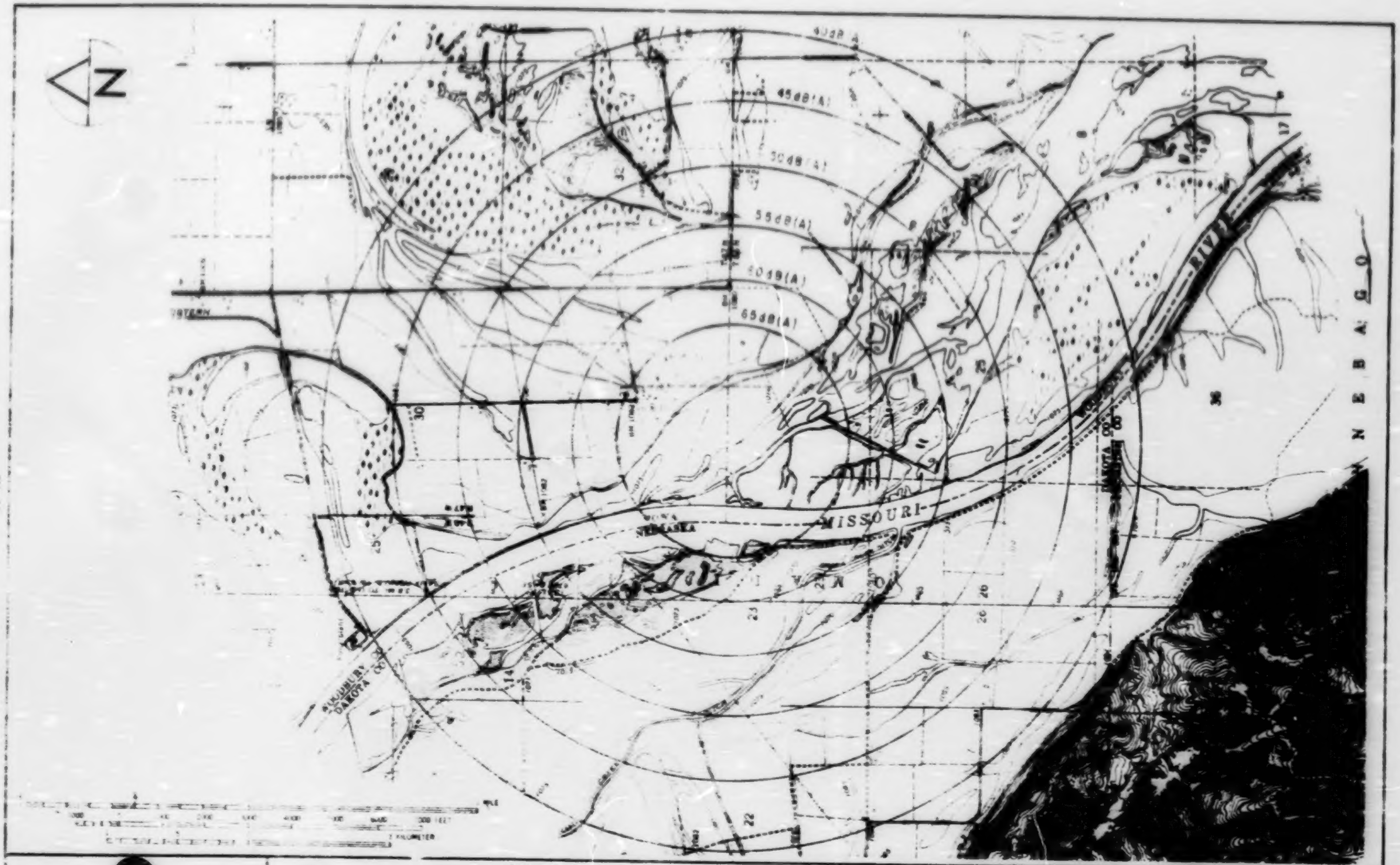
IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

PLANT AND DIKE CONSTRUCTION EQUIPMENT SCHEDULE

DATE: SCALE:

TABLE IV-G-2


N
40dB A
45dB(A)
50dB(A)
55dB(A)
60dB(A)
65dB(A)
MISSOURI
RIVER
NEBRASKA
IOWA
WINNEBAGO
DAKOTA CO.
1 KILOMETER

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IOWA PUBLIC SERVICE COMPANY — GEORGE NEAL UNIT 4

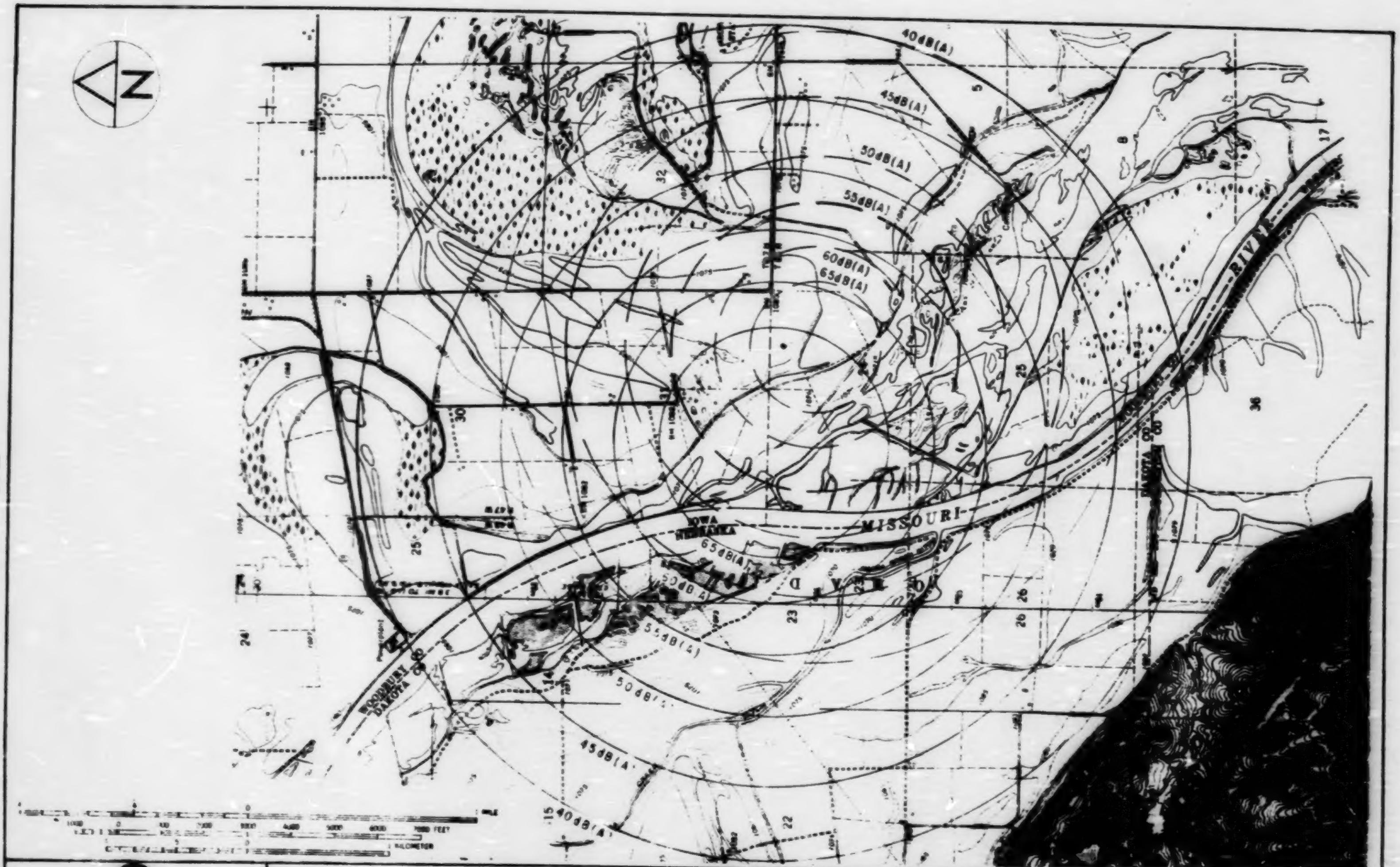
PLANT CONSTRUCTION SOUND CONTOURS

DATE:

SCALE:

EXHIBIT

IV-G-2


40dB(A)
45dB(A)
50dB(A)
55dB(A)
60dB(A)
65dB(A)
65dB(A)
60dB(A)
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50dB(A)
45dB(A)
40dB(A)
MISSOURI
RIVER
IOWA
NEBRASKA
WOODBURY
DAKOTA
N
MILE
FEET
KILOMETER

IOWA PUBLIC SERVICE COMPANY — GEORGE NEAL UNIT 4

PLANT CONSTRUCTION SOUND CONTOURS

DATE:

SCALE:

EXHIBIT
IV-G-3

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Construction noise levels are below the ambient noise level (42 dB(A)L_{90}) and would be only 20 dB(A) without the ambient noise level.

Projections of the representative maximum sound level of the entire construction period as depicted in Exhibits IV-G-2 and 3 show that 12 houses will be impacted by a sound level of 40-55 dB(A). These houses are located around the plant at a distance of 4900-8400 ft southwest to east from the construction center.

At a distance of 3000 ft south-southeast from the construction center, the maximum sound level entering the proposed Snyder-Winnebago Bends Recreational Area will range between 64 and 67 dB(A). However, development of the proposed recreational area will not commence prior to Neal 4 becoming operational.

The peak impact sound level produced by the pile driving operations at a distance of 4900 ft is estimated to be 64 dB(A).

The temporary silenced steam blowout will generate a maximum sound level of about 46 dB(A) at a distance of 4900 ft. This steam blowout will occur intermittently only during the initial startup of the boiler and will not be repeated after the station is brought into operation.

In conclusion, the construction activities at the Neal 4 site are not expected to create significant noise impacts, although some sporadically high levels might occur.

3. Plant Operation and Maintenance

a. Noise Characterization

The sound levels of major sources of noise that will have an impact on Neal Unit 4 environs have been developed from actual field measurements of similar coal-fired plants, analytical calculations and data supplied by various equipment manufacturers. Table IV-G-3 depicts the potential major noise sources, their equipment location and the type of operation, e.g. continuous or intermittent.

Equipment located indoors, such as the turbine generator and pulverizers, radiate noise through the station siding walls. Because Neal Unit 4 is of an indoor type design, it is intrinsically quieter than a similar plant of the outdoor type.

Maintenance activities usually consist of routine inspection and replacement of machinery parts such as pumps and motor components. These activities produce sound levels which are normally lower than plant operation sound levels.

Equipment	Type of* Operation	Equipment Location
Turbine Generator	C	Indoor
Pulverizer	C	Indoor
Induced Draft Fan	C	Indoor
Forced Draft Fan	C	Indoor
Primary Air Fan	C	Indoor
Boiler Feed Pump	C	Indoor
Boiler Feed Pump Turbine	C	Indoor
Main Transformer	C	Outdoor
Auxiliary Transformer	C	Outdoor
Emergency Diesel Generator	I	Indoor
Power Control Valve Discharge Pipe	I	Outdoor
Public Address System	I	Indoor/Outdoor
Coal Crusher	I	Indoor
Stacker Reclaimer	I	Outdoor
Coal Conveyor	I	Outdoor
Coal Car Shaker	I	Outdoor
Precipitator Rapper	C	Indoor
Auxiliary Boiler		
Safety Valve Discharge Pipe	I	Outdoor

*C = Continuous
I = Intermittent

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

MAJOR NOISE SOURCES DURING PLANT OPERATION

DATE:
SCALE:

TABLE
IV-G-3

Ten major sound systems were selected as being representative of continuous operation of Neal Unit 4. They are as follows:

- Two induced draft fans
- Two induced draft fans motors
- Two forced draft fans
- Two primary air fans
- Coal conveyor
- Power station building
- One main transformer
- Two auxiliary transformers
- Coal crusher house
- Plant ventilation system

Sound attenuation, by using materials of acoustical treatment, has been provided as follows.

i. Plant Building

The power station building will be totally enclosed. The turbine generator, boiler, pulverizers and other major auxiliary equipment are located indoors.

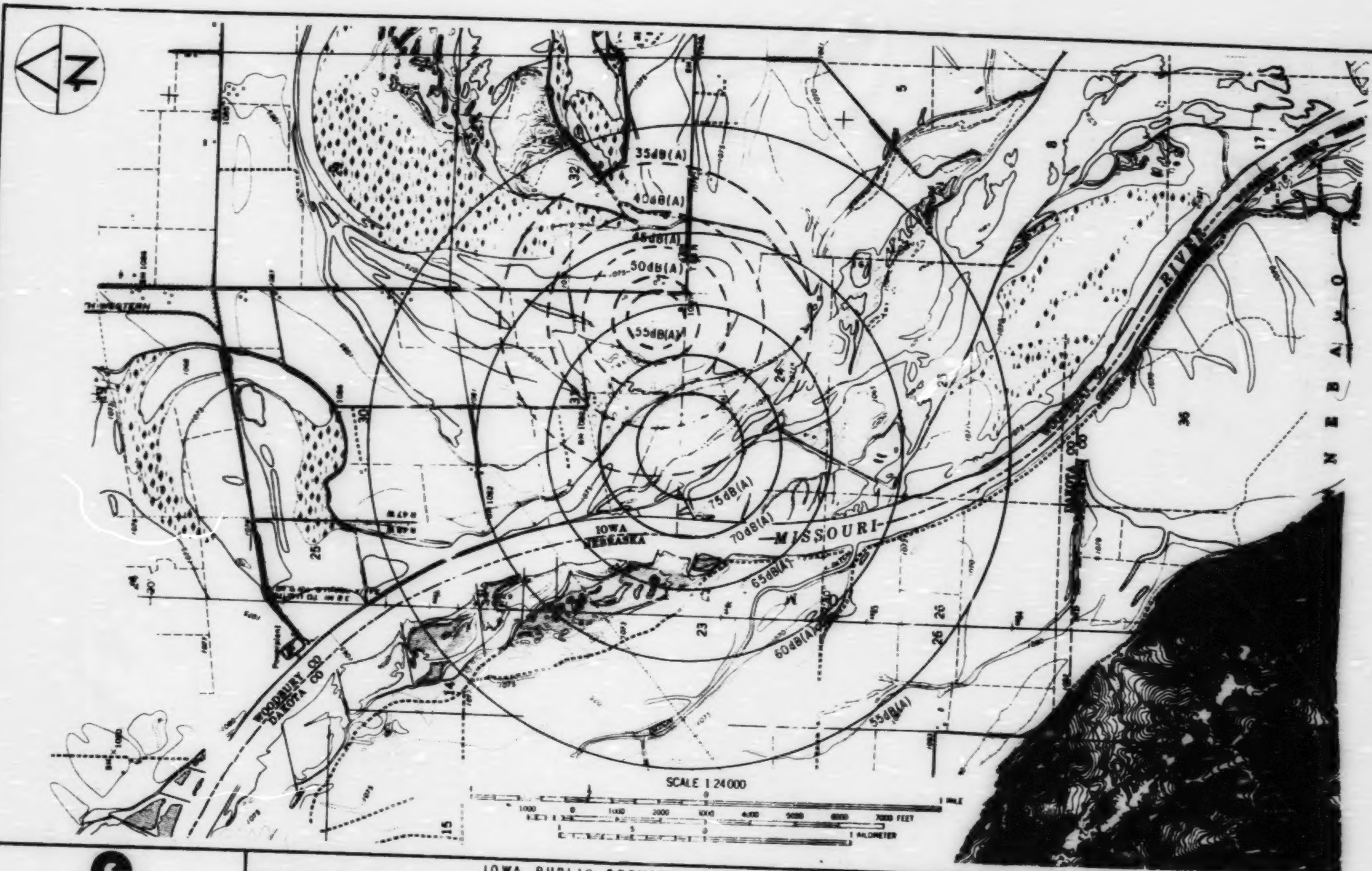
The plant building will employ a four foot, eight inch high concrete block wall around the periphery of the unit. From the top of the concrete block to the building roof, the walls will consist of metal siding, both insulated and uninsulated. The coal crusher house walls and the circulating water intake structure walls will be made of insulated metal siding.

ii. Forced Draft and Primary Air Fans

The two forced draft and two primary air fans will be located in the fan room which will be made of twelve inch thick concrete block. Silencers installed in the enclosure wall will attenuate fan inlet noise.

b. Plant Operation And Maintenance Noise Impact

The ten representative noise sources, taking into account sound attenuation as discussed above, were combined logarithmically and projected in 5 dB(A) intervals using hemispherical spreading and molecular absorption as shown in Exhibit IV-G-4. Because the stacker-reclaimer is located about 2,800 feet from the power station building, it was necessary to


N
35dB(A)
40dB(A)
45dB(A)
50dB(A)
55dB(A)
75dB(A)
70dB(A)
65dB(A)
60dB(A)
55dB(A)
IOWA
NEBRASKA
MISSOURI
RIVER
NEBRASKA
WOODBURY
DAKOTA
SCALE 1:24000
1 MILE
7000 FEET
1 KILOMETER

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IOWA PUBLIC SERVICE COMPANY — GEORGE NEAL UNIT 4

PLANT OPERATION SOUND CONTOURS

DATE:

SCALE:

EXHIBIT

IV-G-4

select two acoustic centers for the plant operation model: one for the stacker-reclaimer and a second for the rest of the plant centered on the power station building.

At a distance of 4900 ft. north of the plant center the continuous sound level produced by the plant operation will be 60 dB(A), which is equivalent to a day-night sound level (Ldn) of about 66 dB(A). One existing dwelling unit will be affected by this value.

At a distance of 3000 ft. south-southeast of the plant, in the proposed Snyder-Winnebago Bends Recreational Area, the maximum daytime sound level produced by the plant will be about 65 dB(A) or an Leq of 65 dB(A). Under the Noise Control Act of 1972, EPA is required to develop criteria identifying the effects of noise on public health and welfare and specify the noise reduction necessary for protection with an adequate margin of safety. EPA's basic "levels" document, which identified noise levels requisite to protection of public health and welfare, was published in March 1974. It concluded that virtually all the population is protected against lifetime hearing loss when annual exposure to noise, averaged on a 24-hour daily level, is less than or equal to 70 A weighted decibels. The noise level found requisite to residential outdoor enjoyment is Ldn ≤ 55 dB.

The results of the analytical calculations have indicated that a maximum Ldn=66 dB(A) at the nearest residence could result from the normal operation of Neal Unit 4. The primary source of the noise is the unsilenced induced draft fans. Provisions are being made to allow for the installation of silencers on these fans if, after operation, the noise from the plant is found to be unacceptable. Due to the significant cost associated with these silencers, the probable conservatism in the analytical analysis and the lack of residential dwellings in close proximity to the plant, the installation of silencers on these fans may not be necessary at the present time. However, IPS is prepared to conduct a boundary noise survey after plant operation is initiated.

Equipment such as the auxiliary boiler safety valves and station power control valves operate intermittently and at unpredictable intervals and are not included in the previous calculations. The maximum "silenced" sound level (intermittent) emitted by the emergency diesel generator at a distance of 3000 ft. will be about 42 dB(A), and about 35 dB(A) at a distance of 4900 ft.

The coal car shaker operates intermittently and only in the winter when frozen coal might be delivered to the plant. The coal shakeout operation could take place every two days with the arrival of the unit train and would last intermittently for about seven to eight hours. The estimated sound level emitted by the coal car shaker entering the proposed Snyder-Winnebago Bends Recreational Area (2500 ft.) will be about 57 dB(A), and at the nearest two residences (4500 ft. east) about 47 dB(A). The estimated sound level at about 4500 ft. east of the unloading hoppers for regular coal deliveries is expected to be 53-59 dB(A) due to the operation of coal car bottom hopper doors.

Maintenance activities at Neal Unit 4 such as replacement of machinery parts will generate a limited amount of noise without any significant impact on noise sensitive land uses.

In conclusion, plant operation and maintenance activities at Neal Unit 4 may have an adverse noise impact on the surrounding area due to estimated noise levels of unsilenced induced draft fans.

4. Transmission Facilities

The additional transmission facilities required in connection with Neal 4 will include two segments:

- A line 1.82 miles in length of 345 KV, and
- A line of approximately 23.3 miles in length of 345 KV.

The maximum noise level produced by the transmission facilities at the right of way line is estimated to have a maximum value of 48 dB(A), which is not expected to create an adverse environmental impact in the area.

V. - EVALUATION OF ALTERNATIVES

A. ALTERNATIVE ENERGY SOURCES

Iowa Public Service Company (IPS), in the process of selecting coal as the energy source for Neal Unit 4 (a base load unit), evaluated several alternatives which included:

- Not Providing Power
- Nuclear Power Plant
- Oil-Fired Power Plant
- Natural Gas-Fired Power Plant
- Gas Turbine Power Plant
- Hydroelectric Power Plant
- Diesel Generator Power Plant
- Other Energy Sources
  - Solar
  - Wind
  - Fusion

The evaluation of alternatives considered environmental impacts, engineering feasibility, and economic factors associated with each alternative. On the basis of this evaluation, which is described in detail in this section, coal was selected because there are reserves of low sulfur, low ash coal available at comparatively low cost and because the environmental impacts of a coal-fired facility can be maintained at a minimal level, possibly less than that for the other alternative fuels. The appropriateness of selecting low sulfur western coal as the energy source is further evidenced by the following detailed review of the above mentioned alternatives that were evaluated.

1. Not Providing Power

Justification of the need for power is described in detail in Section I-C. Though Iowa Public Service Company (IPS) has stopped promoting the sale of electric power and has initiated a conservation effort, the area served by IPS, Interstate Power Company, Northwest Iowa Power Cooperative, Northwestern Public

Service Company, and Corn Belt Power Cooperative, the five major owners of Neal Unit 4, have exceeded previous forecast figures. The most recent prediction by these companies, the Mid-Continent Area Power Pool, and the Mid-Continent Area Reliability Agreement region shows that electric power deficiencies will occur in the latter part of this decade. The remaining eight owners of Neal Unit 4 are Iowa municipalities which need electric power to meet their long-range growth projections.

The five major owners of Neal Unit 4 are regulated by the public service laws of their respective states and they are required to provide electric service to their customers. Based upon the anticipated energy requirements in the service area of the Neal Unit 4 owners, as presented in Chapter I, additional generating capability is essential to meet future needs.

Furthermore, if the possibility of restricting service is viewed as an alternative to Neal Unit 4, it becomes apparent that without an increase in the generating capabilities of these utilities and municipalities, the supply of electrical energy will be less than adequate for customers and for municipal programs. Such a condition when applied "across the board," would restrict the use of electricity for a wide variety of applications and would lead to curtailment of industrial growth.

In view of the obvious hardships which would result for the utilities' customers and municipal programs and in view of their legal obligations as public utilities, the alternative of not supplying power is not feasible.

2. Nuclear Power Plant

An economic study of various alternative plans for meeting the future power requirements of the Mid-Continent Area Power Pool was conducted by a joint intercompany task force in 1970. Units of various sizes and fuel sources were considered. The results of this study indicated that a nuclear installation could be considered from the standpoint of cost.

However, because of the protracted time period, approximately 8 to 10 years, required for installation of a nuclear unit as compared to approximately 4 to 5 years required for installation of a fossil-fueled unit, a nuclear facility for 1979 operation was eliminated as an alternative.

3. Oil-Fired Power Plant

The annual oil requirement for Neal Unit 4 would amount to approximately 193,000,000 gallons at 50 percent capacity factor with a maximum hourly consumption of 44,000 gallons.

In terms of national policy objectives, oil is much more valuable to the overall economy of this country for its other uses, which include space heating. In addition, current policy calls for converting existing and new oil-fired plants to coal to further conserve oil resources.

Thus, oil was not considered acceptable as a fuel supply for the proposed unit.

4. Natural Gas-Fired Power Plant

Another alternative fuel is natural gas. However, there is, at present, a shortage of natural gas throughout the country, and no large scale additional supplies can be anticipated with reasonable certainty.

The nearest major natural gas transmission pipeline in the proximity of the proposed unit is owned and operated by the Northern Natural Gas Company. Due to the severe gas shortage that has persisted over the past few years, the Northern Natural Gas Company is not selling gas to new large nonresidential customers and has even refused to increase deliveries to present customers.

Natural gas requirements for the proposed unit would amount to approximately 27.5 billion cubic feet per year or 740 million cubic feet per day at 50 percent capacity factor. Furthermore, the existing major gas transmission line which services Sioux City is operated at its maximum capacity. Thus, even if sufficient gas were available for the proposed unit, the gas transmission line would not have the capacity to supply the gas. In order to supply gas to the proposed unit from this line at the prescribed high pressure, it would be necessary to construct either a new loop line or add a compression station to boost pressure or both. The increased costs and environmental impact of such an undertaking would be significant.

For the above reasons, and in line with national policy considerations which prefer gas usage for other purposes, natural gas was eliminated as a fuel source.

5. Gas Turbine Power Plant

Since early 1962, electric utilities have rapidly expanded their use of gas turbines to drive generators during peak loads, and to fill capacity gaps caused by delays in bringing base load units on line. Gas turbines are generally unsuited for the continuous operation that is required of base load units due to maintenance requirements and low efficiency. In addition, because gas turbines would be fueled by either gas or oil, which are in short supply, gas turbines have been eliminated from consideration.

6. Hydroelectric Power Plant

Hydroelectric power plants have been eliminated from consideration because there are no feasible sites for such plants that would meet the base load requirements of IPS by the end of this decade.

A pumped storage project would be unsuitable because of a lack of feasible sites for such plants and because base load capacity is required.

7. Diesel Generator Power Plant

There are several plants of IPS employing diesel engines to drive generators. These plants are very small and cannot be used for base loading, and for the same reasons given for gas turbines, are impractical.

8. Other Energy Sources

As a result of the shortage of energy sources in the United States, several new techniques are being sought by government as well as industry to develop energy. These sources have potential commercial use but are not feasible for application to meet IPS needs by the latter part of this decade.

a. Solar

Based on available technology, the practical conversion of solar energy is limited to space exploration and other unique and small scale applications such as residential use. The time-table for application on a large-scale is too distant to consider solar energy as a viable alternative for Neal Unit 4 requirements.

b. Wind

Although wind powered generators are commercially available, the largest unit has only about a 2MW capacity. Due to the intermittent nature of wind and the need for storage of its energy, wind is not capable of providing reliable and steady production of power.

c. Fusion

A fusion reactor derives its power from energy releases when very light elements are combined to form heavier elements. One of the environmental advantages of this mode of power generation is expected to be a significant reduction in the amount of waste heat rejected. At the present time, technology to generate power on a commercial scale has not been developed.

B. ALTERNATIVE PLANT SITES

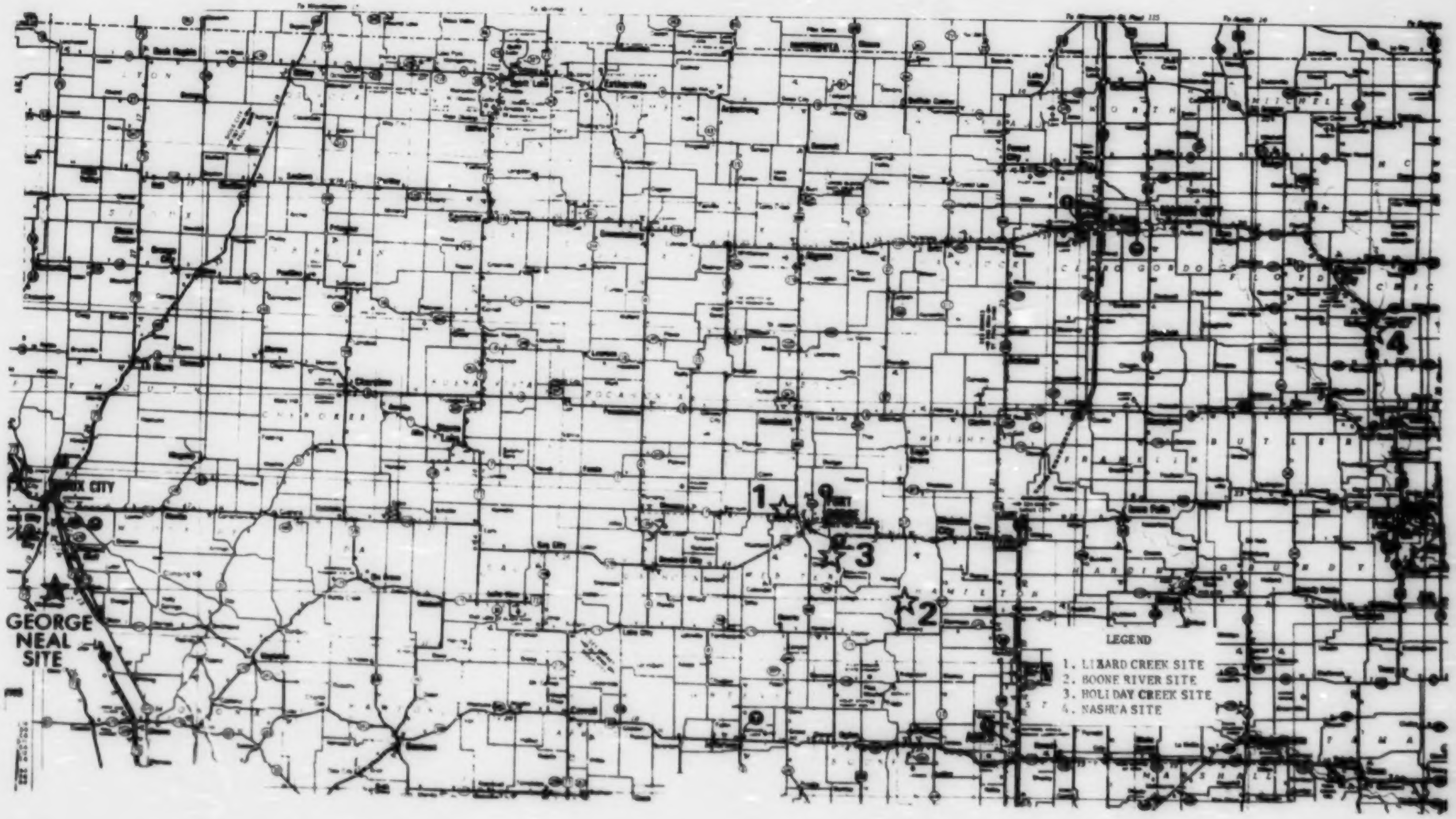
In anticipation of the need for additional power, the applicant (IPS) initiated a survey to identify and analyze candidate sites capable of accepting two 600 megawatt (MW) coal-fired generating units. Neal 4, as the first of these units, would be required to be operational in 1979 while a second unit, as yet unidentified, may be anticipated at some future date. As in most site selection surveys, efforts are made to identify those candidate sites offering the most flexibility for additional power generation development. The utilization of these sites for subsequent units, however, may not be realized but would offer opportunities in accumulating an inventory of potentially viable locations for future needs.

Criteria established for the survey included the following:

- The site should be suitable for development and construction leading to initial power generation in 1979.
- Environmental impact due to plant construction and operation should be minimal.
- The unit should be capable of burning low sulfur coal, and the stack effluent should meet the National Ambient Air Quality Standards.
- The ash pond on the site should be sufficient in size to provide for the accumulation of 30 years of ash with the plant operating at an average capacity factor of 60 percent.
- The site should be suitable for a closed-cycle condenser cooling water system with evaporative type cooling towers, except for one site located on the Missouri River. For this site, consideration was given to the feasibility of once-through cooling.

Prior to the applicant's decision to construct on the present site, the following five locations, identified on Exhibit V-B-1, were considered in the site selection survey. In addition to the Neal site on the Missouri River, three candidate sites, Lizard Creek, Holiday Creek and Boone River, are on the Des Moines River in the vicinity of Fort Dodge, Iowa, while the remaining candidate site is on the Cedar River in the vicinity of Nashua, Iowa.

The survey included both qualitative and quantitative comparisons of the candidate sites taking into consideration engineering/site development factors and environmental factors.


GEORGE NEAL SITE
SIOUX CITY
1
2
3
4
LEGEND
1. LIZARD CREEK SITE
2. BOONE RIVER SITE
3. HOLIDAY CREEK SITE
4. NASHUA SITE

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IOWA PUBLIC SERVICE COMPANY - NEAL UNIT 4

CANDIDATE PLANT

DATE:

SCALE:

EXHIBIT
V-B-1

1. Lizard Creek Site

a. Site Description

This site is located about four miles west of the Des Moines River, on Lizard Creek in the Fort Dodge area. It was determined that at this site the plant would utilize a portion of the Lizard Creek basin as a makeup water storage reservoir. It was further determined that damming would be necessary at a location approximately one mile above the confluence of Lizard Creek and the south branch of Lizard Creek. A 400 acre ash pond would be located on a bluff east of the north-south leg of the reservoir, approximately one mile from the plant area.

b. Engineering and Site Development Factors

This site requires an additional 560 acres for the makeup water storage reservoir. The land requirement of approximately 550 acres for the plant island, cooling tower area, coal storage and ash disposal area is the same as for the other candidate sites.

At this site the till is from 80 to 110 feet thick underlain by shale and sandstone. Therefore, piles can be driven a reasonable depth to a firm base on the shale and sandstone.

This site would require a 2 mile spur from the Chicago and Northwestern Railroad line; however, it would tie in between Clare and Tara just north of Lizard Creek. The site would also require improvement of about one mile of light duty road.

As indicated above, the system includes reservoir storage for makeup water. This would require a pumping station on the Des Moines River at its nearest point to the reservoir. Water would be pumped to the reservoir from the Des Moines River to maintain the reserve supply at maximum levels. The makeup water for the cooling tower system would be supplied directly from the Des Moines River when the flow is sufficient to permit pumping. However, during low flow periods the makeup water would be drawn from the storage reservoir.

c. Environmental Factors

The area surrounding this site is generally zoned "Agricultural". An airport with scheduled service is located approximately 2 miles east. The site area itself is zoned "Conservation District", and the existing land use is mainly residential.

The visual impact of a plant at this site is considered to be significant because of the residential character of the area.

The population within a 3 mile radius, which includes the city of Fort Dodge, is 32,000, and that within a 10 mile radius is 43,276.

The effects of plant construction and operation on water quality is judged to be significant in this area. This is because the main water course, the Des Moines River, is a much smaller river in terms of average flow than the Missouri River. Consequently, the diluting capability is decreased.

The area along the Des Moines River in the vicintiy of Fort Dodge has a floral community of floodplain forests. These forests provide suitable habitat for a majority of the mammals indigenous to the area. In addition, these are the only forested areas for a significant distance in any direction. It is, therefore, judged that a moderate ecological impact would be experienced if a generating plant were to be located at this site.

In addition, impacts on the aquatic and terrestrial ecology are to be expected because Lizard Creek would be dammed and a significant area behind the dam would be flooded. This would affect large areas of forest, which provide recreational opportunities as well as habitat for animals indigenous to the area.

2. Boone River Site

a. Site Description

This site is located approximately one mile south of Homer, Iowa and straddles the line between Webster County and Hamilton County. The area is generally bounded on the east by Prairie Creek which provides water for a makeup water storage reservoir, by Boone River on the south and by the Des Moines River on the west.

b. Engineering and Site Development Factors

The land required for this site could be as much as 1,110 acres, which is considerably greater than for most of the other candidate sites.

There are no boring logs available for the immediate vicinity, but there are surface tills underlain by St. Louis limestone. The limestone is only slightly permeable and is not known to be cavernous.

Rail access to this site requires construction of an 8 mile long spur due north connecting with the Fort Dodge, Des Moines and Southern Railroad. An alternative would be to extend the spur another 2 miles for connection to the Illinois Central line between Fort Dodge and Webster City. Although these distances are considerable, they avoid the necessity of river crossings for the spur.

Light duty roads currently provide access to the site. Some improvement of the roads may be required.

This site would require a pumping station on the west bank of the Des Moines River south of its confluence with Boone River. This station would be designed to supply makeup water directly to the cooling tower basins or to the reservoir on Prairie Creek. A second pumping station would be required at the reservoir which would supply the cooling towers during low flow periods on the Des Moines River.

c. Environmental Factors

The area around the site is mostly agricultural. The river valley, which is forested and used for recreational purposes, is zoned "Conservation District".

The population within a three mile radius of the site is sparse, and that within 10 miles of the site is 10,662. This site was rated high for demographic considerations.

The effects of plant construction and operation on area water quality are judged to be significant because of the relatively low flows in the Des Moines River. The diluting power of the river is therefore limited.

Makeup water for this site is drawn from the Des Moines River when flows permit. A storage reservoir is required to provide surge water to carry plant operation over periods of low river flow. As previously discussed for the Lizard Creek site, the Des Moines River basin is composed of floodplain forests. The forests provide a habitat for the mammals indigenous to the area. The formation of the storage reservoir necessitates the removal of a part of this forested area.

The Des Moines River in this area is aquatically productive. Many areas along the river valley provide sport fishing. The impact of constructing and operating a plant at this site would be significant.

3. Holiday Creek Site

a. Site Description

The Holiday Creek site is located approximately four miles from Fort Dodge, and approximately one mile from Coalville in an area bounded by the Des Moines River on the west and south. It was determined that at this site the plant would utilize a portion of the Holiday Creek basin as a makeup water storage reservoir. It was further determined that damming would be necessary at a location 1,500 feet above the confluence with the Des Moines River, 9 miles downstream of the Fort Dodge gage.

b. Engineering and Site Development Factors

This site requires an additional 250 acres for the makeup water storage reservoir. The land requirement for the plant island, cooling tower area, and coal storage area is approximately 150 acres.

The boring logs for the area indicate 45 to 55 feet of till underlain by 5 to 14 feet of gypsum, which is underlain by shale.

This site would require a 3 mile rail spur from the Fort Dodge, Des Moines and Southern Railroad line which would tie into the Illinois Central Railroad. The site would also require a medium duty highway bridge over Holiday Creek.

As indicated above, the system includes reservoir storage for the makeup water. This would require a pumping station on the Des Moines River at its nearest point to the reservoir. Water should be pumped to the reservoir from the Des Moines River to maintain the reserve supply at maximum levels. The makeup water for the cooling tower system would be supplied directly from the Des Moines River when the flow is sufficient to permit pumping. However, during low flow periods the makeup water would be drawn from the storage reservoir.

c. Environmental Factors

The area around the site is dedicated to agricultural and residential use. Coalville, a small community with a population of about 250, is located one mile southwest, while the city of Fort Dodge is located four miles to the northwest. A quarry is located in the vicinity of the site. Two rail lines run through the general area. The site is zoned "Conservation District".

The population within a 3 mile radius of the site is 1,076 and that within a 10 mile radius is 34,871. The major population center is Fort Dodge with approximately 32,000 persons. This site was rated low for demographic considerations because of its proximity to the Fort Dodge area.

The effects of plant construction and operation on area water quality are considered significant at this site because of the relatively low flows in the Des Moines River which would be used to dilute plant releases and runoffs.

The impact of a plant in this area on terrestrial ecology is substantial. This is caused mainly by the damming of Holiday Creek to provide a storage pond. As previously discussed, the Des Moines River Valley contains forested areas for a significant distance in either direction. This area is used for recreational purposes and provides the only habitat for mammals indigenous to the area. Flooding a large area and destroying the vegetation within the area would alter the scenic and recreational values of the land and reduce the amount of wildlife habitat.

Aquatic life in the area would be affected by the construction of a plant at this site. Damming of Holiday Creek and creating a relatively stagnant pond with constant water level fluctuations would tend to diminish the aquatic productivity of the creek. In addition, silt bearing runoff and plant liquid releases which end up in the river could create potential problems since the diluting potential of the river is relatively small.

4. Nashua Site

a. Site Description

This site is located on the Cedar River, about 2 1/2 miles southwest of Nashua, Iowa in Floyd County. It was determined that because of the low flows in the rivers adjacent to the site (Cedar, Little Cedar, Shell Rock), the source of makeup water for the cooling tower system would be groundwater.

b. Engineering and Site Development Factors

The total land requirement for the plant island, cooling tower area and coal storage area is approximately 470 acres.

Rail access to the site would be provided by a 3 mile spur connecting with the Illinois Central line between Nashua and Waverly. Road access would involve some improvements to a road which intersects US Route 218 due east of the plant.

As previously stated, groundwater would be utilized for makeup water to the cooling towers. Assuming an average well capacity of 3,000 gpm, the site would require a total of 4 wells or 12,000 gpm to supply makeup to the cooling tower system.

c. Environmental Factors

The plant loacted at this site, within two miles of Nashua, would be highly visible from both Nashua and Highway 128, a major highway in the area. In addition, the land use surrounding the site is generally agricultural and residential.

The "Little Brown Church in the Vale" is within two miles and the "Carrie Land Chapman Catt Home" is within seven miles of the site. Both of these are historic sites.

The population within a 3 mile radius of the site is 1,742 and within ten miles is 13,814.

The effects of plant operation and construction on area water quality are considered significant at this site because of the relatively low flows of the adjacent rivers.

No destruction of forested lands is involved at this site, and, therefore, the impacts on terrestrial communities would not be significant.

5. Summary

Based on an evaluation of the engineering/site development factors and environmental factors associated with the five candidate sites, the existing George Neal Steam Electric Station was considered to be the most suitable site for construction and operation of Neal Unit 4 for the reasons outlined below:

- The proximity of the Missouri River would provide large quantities of water for plant operation.
- Analysis of the environmental impact of the once-through discharge of cooling water to the Missouri River, based on the aquatic monitoring data developed by Briar Cliff College for Units 1, 2, and 3 indicated that construction and operation of a plant at this site should not have a significant impact on aquatic biota in the river.
- The proposed unit would be located in the Port Neal Industrial District, and, therefore, the proposed activities would be compatible with the present land use practices of the area.
- Unlike most of the other sites, the Neal site is not a forested area, and, consequently, the impact on terrestrial communities would be less significant.
- The Neal site is about 14 miles from Sioux City, Iowa, the major population center in the area.
- A low sulfur coal-fired unit at this site could meet the National Ambient Air Quality Standards in combination with the existing George Neal Station.
- The site would be in close proximity to the transmission facilities and railroad line servicing the existing George Neal Steam Electric Station.

C. PLANT DESIGN ALTERNATIVES

1. Cooling Water System

a. Introduction

This section presents an evaluation of the condenser cooling water systems considered as viable alternatives to the once-through cooling water system proposed for Neal Unit 4. The three alternative systems discussed in this section are as follows:

- A closed-cycle cooling water system with a natural draft cooling tower;
- A closed-cycle cooling water system with a round mechanical draft cooling tower;
- A closed-cycle water system with a rectangular mechanical draft cooling tower.

Other alternative condenser cooling water systems, such as spray ponds, cooling ponds and dry cooling systems were considered for this site but were eliminated because of economic, environmental impact and/or engineering feasibility factors. More specifically, cooling ponds and spray ponds were eliminated from consideration because of the lack of available land at the site. Spray ponds were also considered undesirable because of the lack long-term operational experience with spray equipment. Dry cooling systems or combination wet/dry systems were eliminated from consideration because of their excessive cost and because these systems are required primarily in areas where there is a lack of adequate water supply.

A discussion of evaluation methods is presented in Appendix A-V-C which dwells primarily on the methods of evaluating environmental impact of cooling towers. The environmental impact evaluation methods pertain to predictions of salt deposition and fogging frequencies for cooling towers and the establishment of terrestrial ecology impact criteria. In addition, the criteria used in performing the economic analysis for each alternative cooling water system are presented. The impact analysis of the once-through system is discussed in detail in Chapter IV.

The conceptual designs for the three viable alternative condenser cooling systems are presented herein. Based on these conceptual designs, comparative cost estimates have been developed for each cooling water system in absolute terms and in differential terms relative to the selected once-through system. An evaluation of the environmental impact on aquatic and terrestrial ecology associated with each alternative is also presented. These analyses, along with an evaluation of the aesthetic impact inherent in each system, are used to develop comparisons between the alternatives and the selected once-through cooling water system.

b. Natural Draft Cooling Tower

i. Engineering Description

Exhibit V-C-1 presents a conceptual plot plan of Neal Unit 4 utilizing a closed-cycle cooling water system with a natural draft cooling tower. Approximately 317,400 gpm of condenser cooling water would be passed through the natural draft cooling tower to remove about 2.7 x 10^9 Btu/hr of waste heat. The temperature rise across the condenser would be about 17°F during plant operation at 100 percent capacity factor. The cooling tower would be designed for a wet bulb temperature of 77°F and a dry bulb temperature of 89°F. Based on an approach to wet bulb temperature of 18°F, the physical dimensions of the natural draft cooling tower were determined to be as follows:

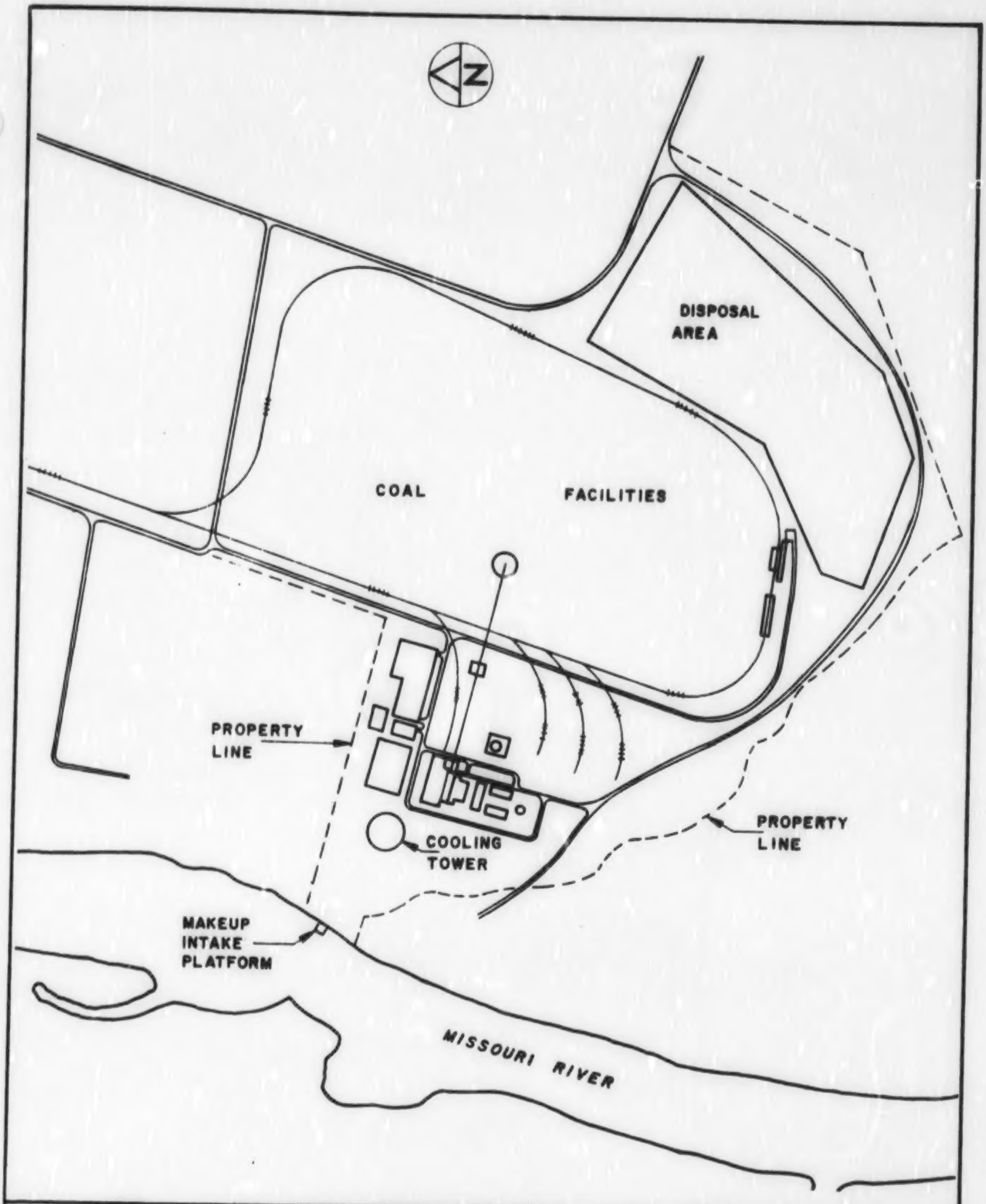
Base Diameter	370 feet
Overall Height	350 feet
Top Diameter	160 feet

Three vertical one-half capacity circulating water pumps would be provided in a pump chamber attached to the cooling tower basin. During normal plant operation, two circulating water pumps would be operating while the third pump would act as a standby.

Makeup water would be provided to the cooling tower by pumps contained in vertical rotary drum screens located on a platform constructed along the bank of the Missouri River. Four makeup water pumps would be installed on the concrete platform. Three pumps would provide makeup water to the cooling tower basin while the remaining pump would act as a standby. The rotary drum screen assembly includes a vertical turbine pump operating with a revolving steel casing whose lower end is fitted with a perforated steel plate which acts as the screening mechanism. Water is drawn through the perforated plate by the pump and is piped to the cooling tower basin. As the screen casing revolves, high-pressure spray nozzles clean off any debris on the screening surface on the downstream side.

The concrete intake platform would be approximately 36 feet wide and would extend out about 5 feet from the existing river bank. Exhibit V-C-2 presents a schematic drawing of this makeup water intake platform. The structure would be supported by two steel H-piles and sheet piling along the river bank. The structure would be enclosed on three sides by trashracks.

The blowdown from the cooling tower basin would be discharged directly to the Missouri River. The blowdown would flow by gravity through a concrete pipe that would extend out from the river bank below the river surface.


N
DISPOSAL AREA
COAL
FACILITIES
PROPERTY LINE
COOLING TOWER
PROPERTY LINE
MAKEUP INTAKE PLATFORM
MISSOURI RIVER

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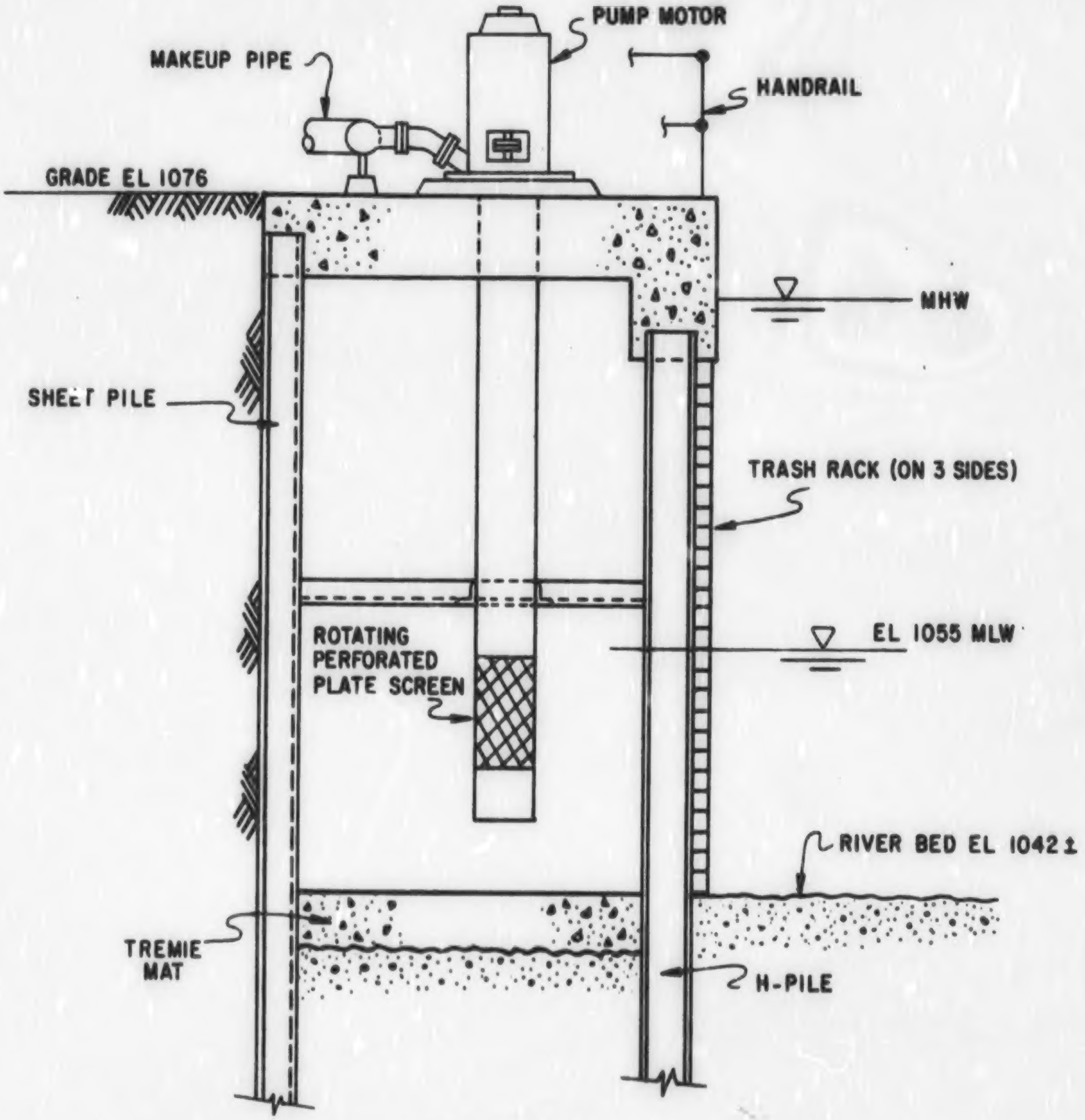
IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

NATURAL DRAFT COOLING TOWER SYSTEM
NEAL UNIT 4 CONCEPTUAL PLOT PLAN

EXHIBIT
V-C-1

DATE:

SCALE:


PUMP MOTOR
MAKEUP PIPE
HANDRAIL
GRADE EL 1076
MHW
SHEET PILE
TRASH RACK (ON 3 SIDES)
ROTATING PERFORATED PLATE SCREEN
EL 1055 MLW
RIVER BED EL 1042±
TREMIE MAT
H-PILE

SECTION

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

MAKEUP WATER INTAKE PLATFORM

DATE:

SCALE:

EXHIBIT
V-C-2

ii. Environmental Impact

▪ Effects on Aquatic Ecology

Biological and ecological effects of closed-cycle cooling incorporating a natural draft cooling tower would not be significant. Entrapment of juvenile and adult fish would be negligible, and fractional amounts of plankton, macroinvertebrates, and fish eggs and larvae would be entrained in the makeup water. In January, at low river flows of 8500 cubic feet per second (cfs), approximately 0.24 percent of the water would be required for makeup, whereas in August, when low flows are in the range of 31,300 cfs, only 0.06 percent of the river water would be required. During May, June, and July - the months of peak fish spawning activity - approximately 0.07 percent of the Missouri River flow would be required for makeup.

No significant ecological effects would be expected as a result of discharging cooling tower blowdown to the river. Table V-C-1 presents the average ambient water quality of the Missouri River at Neal Unit 4. Even at five cycles of concentration and a maximum blowdown rate of 5 cfs, effects on the Missouri River would be negligible due to the rapid mixing of the effluent. For example, the total dissolved solids (TDS) level would be within the allowable limits within a short distance of the point of discharge. Table V-C-2 presents the monthly average blowdown temperatures from the natural draft cooling tower. As stated, because of the rapid dilution of the effluent, thermal effects on river biota should be insignificant.

▪ Effects on Terrestrial Ecology

Salt deposition rates for a natural draft cooling tower located at Neal Unit 4 are presented in Table V-C-3. Exhibit A-V-C-1 presents the distribution of these rates and location of potentially affected vegetation types. Spring season rates were considered more critical than those of other seasons as some plants, such as soybeans, are more sensitive to the chloride ion during the early growth stages. Also, it has been noted that seedlings obtain water from the upper soil surface, where temporary maximum salt concentrations can occur before soluble materials are transported by leaching and erosion.[1]

Lack of information on plant injury resulting from aerial deposition of sulfate salts precludes accurate prediction of effects of cooling towers on vegetation at Neal Unit 4. It may be assumed, however, that the sulfate ion is no more toxic than chloride: in general, sensitive plants are only affected by high concentration of the former[2], whereas species particularly sensitive to chloride such as tobacco and fruits are known to respond to relatively low chloride concentrations.[1] Incorporating this assumption of equivalent toxicities and an estimate of cooling tower salt composition of 75 percent sulfate into criteria for calculating a salt deposition rate which will not

Description		Concentration
pH (unit)		8.1
Total alkalinity	(mg/l as $CaCO_3$)	170
Total hardness	(mg/l as $CaCO_3$)	250
Ca^{++}	(mg/l as $CaCO_3$)	155
Mg^{++}	(mg/l as $CaCO_3$)	95
Na^{++}	(mg/l as $CaCO_3$)	137
K^+	(mg/l as $CaCO_3$)	7
HCO_3^-	(mg/l as $CaCO_3$)	170
$CO_3^=$	(mg/l as $CaCO_3$)	0
Cl	(mg/l as $CaCO_3$)	16
$SO_4^=$	(mg/l as $CaCO_3$)	208
NH_3-N	(mg/l as N)	0.25
NO_3-N	(mg/l as N)	0.30
Total Phosphate	(mg/l as P)	0.21
Silica	(mg/l as SiO_2)	9.7
TDS	(mg/l)	480.
Total Suspended Solids	(mg/l)	150.
BODS	(mg/l)	2.9

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

AVERAGE WATER QUALITY OF THE MISSOURI RIVER IN THE VICINITY OF NEAL UNIT 4

DATE: SCALE:

TABLE V-C-1

Month	Temperature (F)
January	55
February	58
March	64
April	72
May	79
June	85
July	87
August	88
September	82
October	75
November	65
December	59

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

MONTHLY AVERAGE BLOWDOWN TEMPERATURE
NATURAL DRAFT COOLING TOWER

DATE: SCALE:

TABLE
V-C-2

Reproduced from
best available copy.

Distance From Tower (ft)	Direction from Tower							
	S	SW	W	NW	N	NE	E	SE
500	53.0	40.0	60.0	207.0	40.0	15.0	17.0	119.0
1,000	13.0	7.7	7.7	18.0	9.7	6.9	7.2	32.0
1,500	4.2	2.8	3.8	8.8	4.6	3.1	3.1	8.1
2,000	4.5	3.1	4.1	9.2	5.0	3.2	3.2	8.7
3,000	4.0	2.7	3.7	8.5	4.9	2.7	2.5	7.5
4,000	2.6	1.7	2.2	5.9	3.5	1.5	1.3	5.4
5,000	1.9	1.2	1.8	4.4	2.7	1.1	1.0	4.0
10,000	1.0	1.0	1.0	2.2	1.1	1.0	1.0	1.8

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

NATURAL DRAFT COOLING TOWER
ANNUAL SALT DEPOSITION, LBS/ACRE/YEAR

DATE: SCALE:

TABLE
V-C-3

affect terrestrial biota, a rate is arrived at of 1.6 lb salt/acre/month. Inspection of Exhibit A-V-C-1 indicates that only a small portion (50 acres) of riparian shrub land is exposed to salt deposition greater than 1.6 lb/acre/month, indicating that natural draft cooling towers are not likely to affect vegetation in the area of Neal Unit 4 through aerial impaction of salt crystals on leaf blades.

Chloride ion would comprise only two to three percent of the cooling tower salts (based on preliminary calculations), and would not be deposited to any significant degree at the rates shown in Exhibit A-V-C-2. A natural draft cooling tower maximum chloride deposition of 0.1 lb chloride/acre/month is considerably smaller than amounts added to the soil through precipitation, which have been shown to range in the United States from 0.8 to over 8.0 lb chloride/acre/month.[3]

Operation of a natural draft cooling tower would not be expected to significantly alter salinity of nearby soils. Deposition of sulfur by natural precipitation can range up to 17 lbs/acre/month, with no deleterious effects.[4]

iii. Aesthetic Impact

The natural draft cooling tower system will have a definite aesthetic impact on the surrounding environment. The cooling tower, along with the Unit 4 stack, would be visible for miles from any direction. In addition to the physical height of both structures, their associated vapor plumes would be visible during certain periods of the year. The visual impact of the natural draft cooling tower would be greater than that of the stack because of the opacity of the plume and width of the cooling tower. The diameter of the natural draft cooling tower would vary from 160 feet at the top to a maximum diameter of 370 feet at the tower base.

iv. Investment Cost

The investment cost for the closed-cycle condenser cooling water system with a natural draft cooling tower has been developed based on the evaluation method discussed in Appendix A-V-C. The estimate for the natural draft cooling tower system includes the cost of the concrete cooling tower, cooling tower basin, makeup water intake platform, pumps, piping, valves and electrical equipment. The initial capital investment cost was estimated at $14,500,000 for the base year 1977. The total investment costs including operating, fuel and maintenance costs are presented below:

	ABSOLUTE COST
▪ Total Generating Cost (Present worth value)	$35,465,000
▪ Total Generating Cost (Annualized)	$ 2,858,000

c. Round Mechanical Draft Cooling Tower System

i. Engineering Description

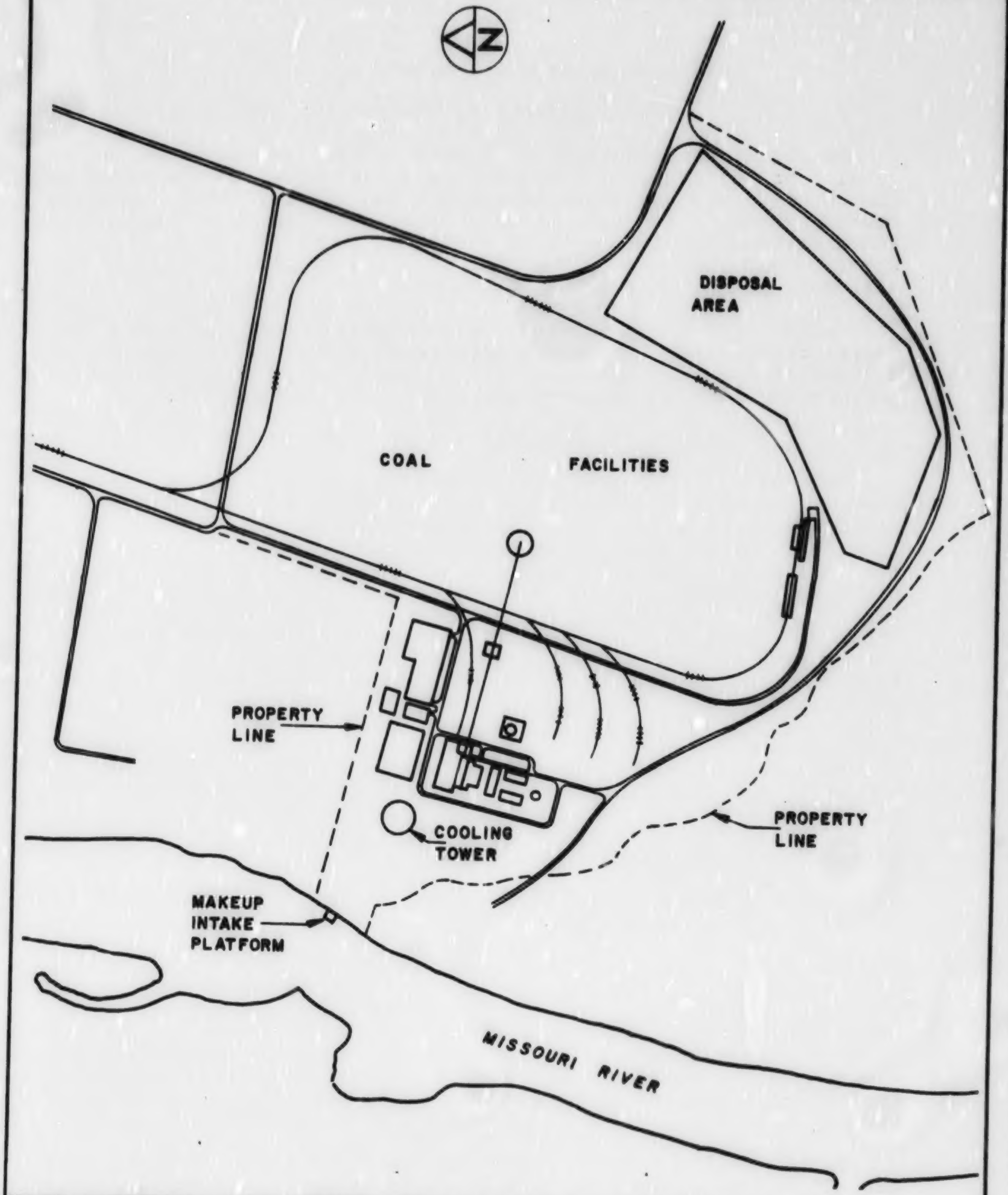
Exhibit V-C-3 presents a conceptual plot plan of Neal Unit 4 utilizing a closed-cycle cooling water system with a round mechanical draft cooling tower. Approximately 317,400 gpm of condenser cooling water would be passed through the mechanical draft cooling tower to remove about 2.7×10^9 Btu/hr of waste heat. The temperature rise across the condenser would be about 17 F during plant operation at 100 percent capacity factor. The cooling tower would be designed for a wet bulb temperature of 77 F and a dry bulb temperature of 89 F. Based on an approach to wet bulb temperature of 18 F, the physical dimensions of the round mechanical draft cooling tower were determined to be as follows:

▪ Number of Cells	12
▪ Overall Diameter	315 feet
▪ Overall Height	62 feet

Three vertical one-half capacity circulating water pumps would be provided in a pump chamber attached to the cooling tower basin. During normal plant operation, two circulating pumps would be operating while the third pump would act as a standby.

Makeup water would be provided to the cooling tower by pumps contained in vertical rotary drum screens located on a platform constructed along the bank of the Missouri River. As in the previous case with the natural draft cooling tower, four makeup water pumps would be installed on the concrete intake platform. Three pumps would provide makeup water to the cooling tower basin while the remaining pump would act as a standby. The description of the makeup water intake platform and the screened pumps is the same as that presented in the previous section for the natural draft cooling tower system.

The blowdown from the cooling tower basin would be discharged directly to the Missouri River as discussed in the previous section.


N
DISPOSAL AREA
COAL FACILITIES
PROPERTY LINE
PROPERTY LINE
COOLING TOWER
MAKEUP INTAKE PLATFORM
MISSOURI RIVER

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

ROUND MECHANICAL DRAFT COOLING
TOWER SYSTEM NEAL UNIT 4
CONCEPTUAL PLOT PLAN

EXHIBIT
V-C-3

DATE:

SCALE:

ii. Environmental Impact

• Effects on Aquatic Ecology

No significant ecological effects would be expected as a result of discharging cooling tower blowdown to the river as discussed in the previous section for the natural draft cooling tower system. As indicated, even at 5 cycles of concentration and a maximum blowdown rate of 5 cfs, effects on the Missouri River would be negligible due to the rapid mixing of the effluent.

Table V-C-4 presents the monthly average blowdown temperatures from the round mechanical draft cooling tower. As previously stated, because of the rapid dilution of the effluent, temperature effects on river biota would be insignificant.

• Effects on Terestrial Ecology

Salt deposition rates for a round mechanical draft cooling tower located at Neal Unit 4 are presented in Table V-C-5. Exhibit A-V-C-2 presents the distribution of these rates and locations of potentially affected vegetation types. The reasons for considering spring season values were discussed in the previous section on natural draft cooling towers, where criteria were presented for estimating a minimal deposition rate below which no effects on terrestrial vegetation would be expected. Terrestrial communities experiencing rates higher that 1.6 lb salt/acre/month include cottonwood, mixed cottonwood, riparian shrub, and sand dune vegetation types, as well as agricultural land.

Sulfate is generally not retained in soils with pH values higher than 6.0 to 6.5.[5] Exhibit V-C-4 depicts the soil reactions of lands surrounding Neal Unit 4, and indicates that accumulation of soil sulfate would be an unlikely phenomenon in the well-drained portions of this area.

Since atmospheric sulfur compounds are dissolved in rainwater, lands near industrial sulfur sources generally receive large quantities of this element through precipitation. Amounts as high as 25 lbs sulfate/acre/month are not uncommon.[6] Because only 75 percent of the salt emitted by towers at Neal Unit 4 is sulfate, areas which would be exposed to a deposition of 25 lbs sulfate/acre/month would correspond to areas where a cooling tower salt deposition is 33 lbs salt/acre/month. Exhibit A-V-C-2 shows that a cooling tower salt deposition of this magnitude is restricted mostly to an area contained within the Neal Unit 4 boundaries.

Since cooling tower deposition is continuous, salt crystals are allowed to accumulate between rains on leaf blades, whereas natural precipitation in effect, washes the leaves and transports a large fraction of the dissolved ions into the soil. The

Month	Temperature (F)
January	73
February	74
March	77
April	81
May	85
June	89
July	91
August	91
September	87
October	83
November	78
December	75

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

MONTHLY AVERAGE BLOWDOWN TEMPERATURE
MECHANICAL DRAFT COOLING TOWER

DATE: SCALE:

TABLE
V-C-4

Distance From Tower (ft)	Direction from Tower							
	S	SW	W	NW	N	NE	E	SE
500	505.0	385.0	542.0	1857.0	390.0	138.0	279.0	1197.0
1.000	108.0	68.0	63.0	151.0	93.0	56.0	87.0	282.0
1.500	69.0	46.0	55.0	109.0	75.0	54.0	81.0	116.0
2.000	22.0	15.0	20.0	54.0	36.0	15.0	19.0	49.0
3.000	22.0	15.0	20.0	54.0	35.0	14.0	18.0	48.0
4.000	13.0	7.2	9.0	31.0	24.0	6.4	7.0	32.0
5.000	13.0	7.2	9.0	31.0	24.0	6.4	7.0	32.0
10.000	1.0	1.0	0.0	1.0	1.0	1.0	1.0	1.0

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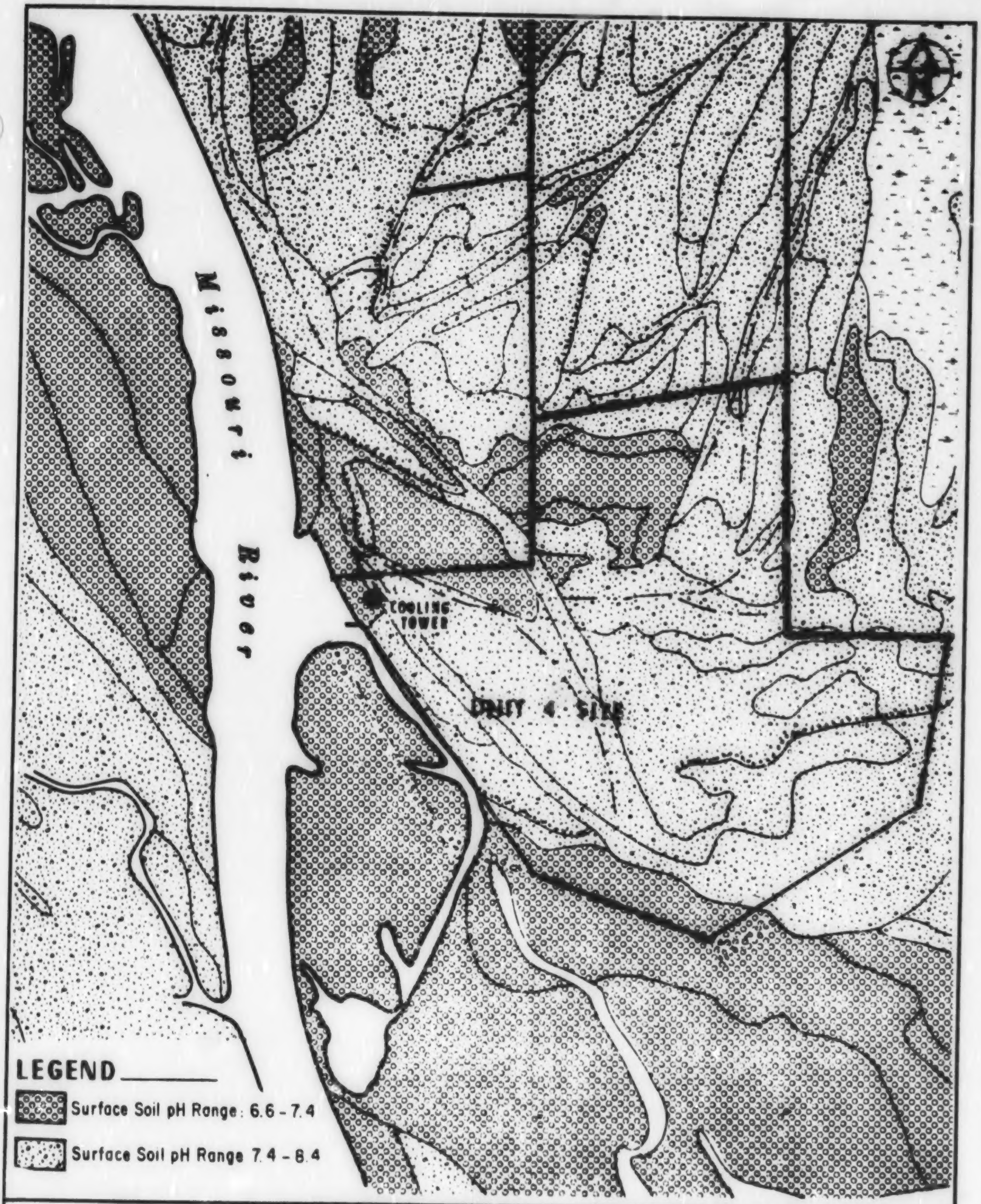
IOWA PUBLIC SERVICE Co. – NEAL UNIT 4

ROUND MECHANICAL DRAFT COOLING TOWER
ANNUAL SALT DEPOSITION, LBS/ACRE/YEAR

DATE:
SCALE:

TABLE
V-C-5


Missouri River
COOLING TOWER
UNIT 4 SITE
LEGEND
Surface Soil pH Range: 6.6 - 7.4
Surface Soil pH Range 7.4 - 8.4

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

pH RANGES OF SURFACE SOILS IN
UNIT 4 AREA

EXHIBIT
V-C-4

DATE:

SCALE:

quantity of sulfate that plants can tolerate, when the salt particles accumulate on leaf surfaces in this manner, is not known.

Table V-C-6 lists woody plants which are known to be sensitive to sodium chloride spray. Smooth sumac and greenbriar are important shrub and vine components of terrestrial communities in the Missouri River floodplain.

As discussed in Appendix A-V-C, chloride deposition rates less than 1.2 lb/acre/month are not expected to injure the most chloride sensitive plants (tobacco and some fruits). Since only approximately 2 1/2 percent of Neal Unit 4 cooling tower salt is chloride, this rate translates into a salt deposition rate at Neal Unit 4 of 48 lb/acre/month. Only vegetation growing within the boundaries of Neal Unit 4 and near the cooling tower would be exposed to potentially injurious quantities of this ion.

The soil salinities of farmlands in the area of Neal Unit 4 would not be expected to change due to operation of a round mechanical draft cooling tower; with sufficient drainage, deposited salts would be leached into the groundwater system. Poorly drained nonagricultural areas, however, could experience small changes in sulfur concentrations.

iii. Aesthetic Impact

The aesthetic impact of the round mechanical draft cooling tower system on the surrounding environment would not be significant. The overall height of the cooling tower would be 62 feet and, while the cooling tower would be visible from both the river and a portion of the site property line, the major aesthetic impacts would be incurred by the plant island, the Neal Unit 4 stack and, the coal handling facilities. However, during periods of the year, a high altitude vapor plume would be visible from the round mechanical draft cooling tower.

iv. Investment Cost

The investment cost for the closed-cycle condenser cooling water system with a round mechanical draft cooling tower has been developed based on the evaluation method discussed in Appendix A-V-C. The estimate for the round mechanical draft cooling tower system includes the cost of the concrete cooling tower, cooling tower basin, makeup water intake platform, pumps, piping, valves and electrical equipment. The intital capital investment cost was estimated at $9,400,000 for the base year 1977. The total investment costs including operating, fuel and maintenance costs are presented below:

Black jack oak	(Quercus marilandica)
Spanish oak	(Quercus palustris)
Red maple	(Acer rubra)
Honey locust	(Gleditsia tricanthos)
Wild black cherry	(Prunus serotina)
Apple	(Malus spp.)
Flowering dogwood	(Cornus florida)
Sassafras	(Sassafras spp.)
Red bud	(Cercis canadensis)
Pepper bush	(Clethra alnifolia)
Hawthorn	(Crataegus spp.)
Smooth sumac	(Rhus glabra)
Virginia creeper	(Parthenocissus quinquefolia)
Greenbriar	(Smilax spp.)

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

WOODY PLANTS SENSITIVE TO SODIUM CHLORIDE SALT SPRAY

DATE:
SCALE:

TABLE V-C-6

	ABSOLUTE COST
▪ Total Generating Cost (Present worth value)	$27,635,000
▪ Total Generating Cost (Annualized)	$ 2,227,000

d. Rectangular Mechanical Draft Cooling Tower System

i. Engineering Description

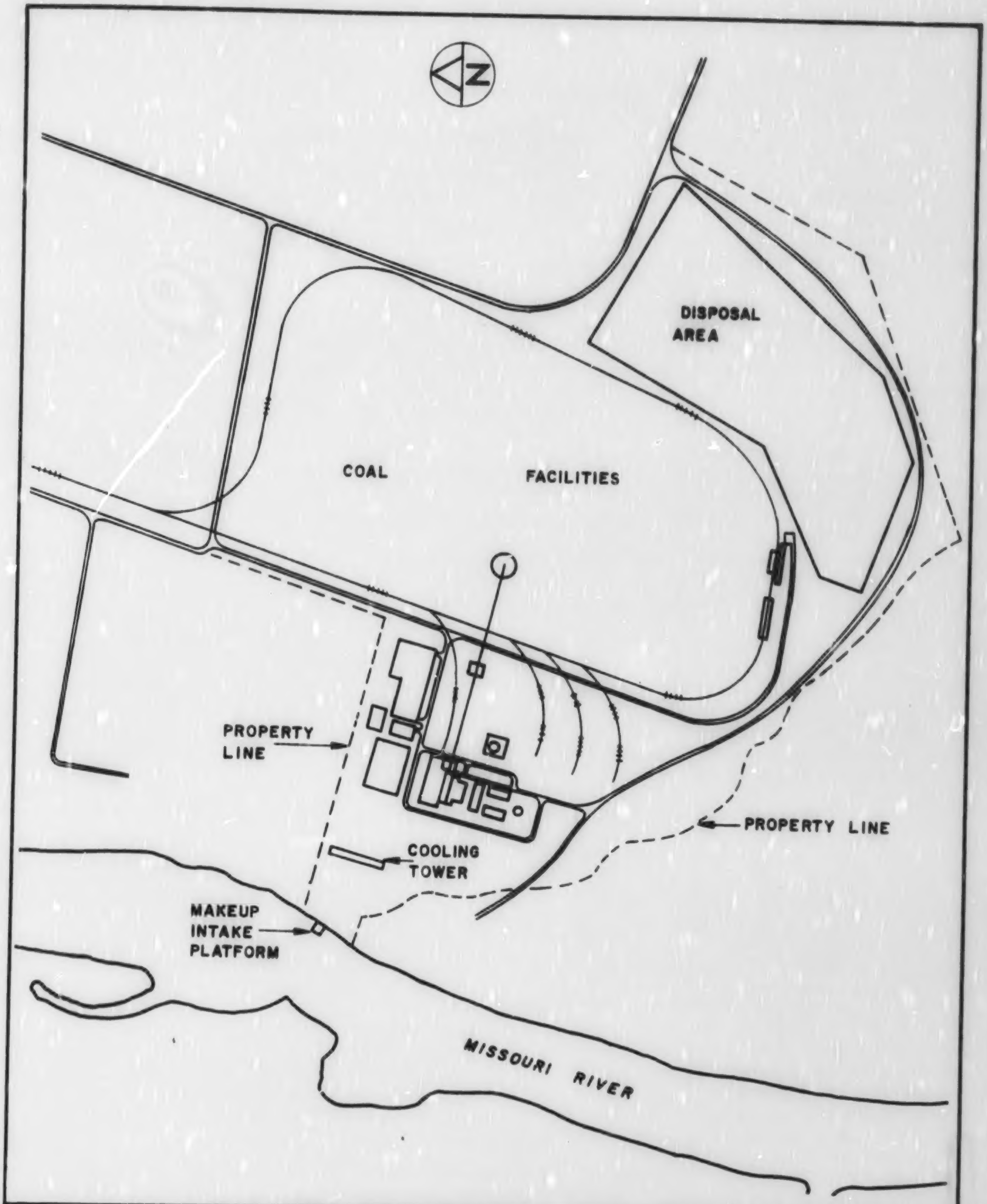
Exhibit V-C-5 presents a conceptual plot plan of Neal Unit 4 utilizing a closed-cycle cooling water system with a rectangular mechanical draft cooling tower. Approximately 317,400 gpm of condenser cooling water would be passed through the mechanical draft cooling tower to remove about 2.7 x 10^9 Btu/hr of waste heat. The temperature rise across the condenser would be about 17°F during plant operation at 100 percent capacity factor. The cooling tower would be designed for a wet bulb temperature of 77°F and a dry bulb temperature of 89°F. Based on an approach to a wet bulb temperature of 18°F, the physical dimensions of the rectangular mechanical draft cooling tower were determined to be as follows:

▪ Number of Cells	12
▪ Overall Width	70 feet
▪ Overall Length	480 feet
▪ Overall Height	60 feet

Three vertical one-half capacity circulating water pumps would be provided in a pump chamber attached to the cooling tower basin. During normal plant operation, two circulating water pumps would be operating while the third pump would act as a standby.

Makeup water would be provided to the cooling tower by pumps contained in vertical rotary drum screens located on a platform constructed along the bank of the Missouri River. As in the previous cases with the natural draft and round mechanical draft cooling tower systems, four makeup pumps would be installed on the concrete intake platform. Three pumps would provide makeup water to the cooling tower basin while the remaining pump would act as a standby. The description of the makeup water intake platform and the screened pumps is the same as that presented in the section for the natural draft cooling tower system.

The blowdown from the cooling tower basin would be discharged directly to the Missouri River as discussed previously in the section on the natural draft cooling tower.


N
DISPOSAL AREA
COAL
FACILITIES
PROPERTY LINE
PROPERTY LINE
COOLING TOWER
MAKEUP INTAKE PLATFORM
MISSOURI RIVER

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IOWA PUBLIC SERVICE Co. - NEAL UNIT 4

RECTANGULAR MECHANICAL DRAFT
COOLING TOWER NEAL UNIT 4
CONCEPTUAL PLOT PLAN

DATE:
SCALE:

EXHIBIT
V-C-5

ii. Environmental Impact

- Effects on Aquatic Ecology

No significant ecological effects would be expected as a result of discharging cooling tower blowdown to the river as discussed in the section on the natural draft cooling tower system. As indicated, even at 5 cycles of concentration and a maximum blowdown rate of 5 cfs, effects on the Missouri River would be negligible due to the rapid mixing of the effluent. Table V-C-4 presents the monthly average blowdown temperatures from the mechanical draft cooling tower. As previously stated, because of the rapid dilution of the effluent, temperature effects on river biota would be insignificant.

- Effects on Terrestrial Ecology

Salt deposition rates were not calculated for rectangular mechanical draft cooling towers at Neal Unit 4 because reliable estimates could be made from those deposition rates calculated for round mechanical draft cooling towers. Although the total salt emission would be the same as that for round mechanical draft cooling towers, deposition rates would range up to approximately four times higher due to a lower plume rise and a corresponding decrease in deposition area.

Salt deposition rates would likely exceed the 1.6 lb/acre/month criteria developed previously. Nearby riparian shrub type of vegetation, which serves as a productive habitat for deer, pheasant and waterfowl, would have a greater potential for injury. The fourfold increase in concentrations of deposited sulfate ions may be a source of more concern to this productive riparian community.

Because salt deposition from a rectangular mechanical draft cooling tower is concentrated in an area near the tower itself, deleterious effects on agricultural crops and soils are not expected.

iii. Aesthetic Impact

The aesthetic impact of the rectangular mechanical draft cooling tower system on the surrounding environment would not be significant. The overall height of the cooling tower would be 60 feet and, while the cooling tower would be visible from both the river and a portion of the site property line, the major aesthetic impact would be due to the plant island, the Neal Unit 4 stack and the coal handling facilities. However, during periods of the year, a low altitude vapor plume would be visible from the rectangular mechanical draft cooling tower.

iv. Investment Cost

The investment cost for the closed-cycle condenser cooling water system with a rectangular mechanical draft cooling tower has been developed based on the evaluation method discussed in Appendix A-V-C. The estimate for the rectangular mechanical draft cooling tower system includes the cost of the concrete cooling tower, cooling tower basin, makeup water intake platform, pumps, piping, valves and electrical equipment. The initial capital investment cost was estimated at $9,700,000 for the base year 1977. The total investment costs including operating, fuel and maintenance costs are presented below:

	ABSOLUTE COST
■ Total Generating Cost (Present worth value)	$28,258,000
■ Total Generating Cost (Annualized)	$ 2,299,000

e. Comparison of Systems

i. Environmental Impact Comparison

The evaluation of the environmental impact of the alternative condenser cooling water systems on the aquatic and terrestrial ecology indicates that none of the alternatives should have a significant adverse impact on the environment. The once-through cooling water system, discussed in Chapter IV, would have its greatest, although not necessarily significant, impact on the aquatic ecology, while the closed-cycle cooling tower systems would impact greatest on the terrestrial communities.

In most cases, the impact of the cooling water system on the environment would be minimal. However, there is a possibility that salt deposition from the rectangular mechanical draft cooling tower might expose portions of the riparian shrub in the Snyder Bend recreational area to possibly injurious concentrations of chlorides. In addition, the consumptive water use for the closed-cycle cooling tower systems would be about 7200 acre-feet per year (ac-ft/yr) while the once-through system would have negligible consumptive water use (20 acre feet per year). The aesthetic impact inherent in each cooling water system has also been discussed and the impact shown to be minimal in all cases except for the natural draft cooling tower system.

ii. Engineering Cost Comparison

The evaluation of the engineering costs for the condenser cooling water systems is based on the total generating cost (present worth) associated with each system. As discussed in Appendix A-V-C, the cost estimate prepared for each alternative system were based on conceptual system designs developed from preliminary plot plans and plant operating characteristics and do not include the cost of the condenser. The total generating cost (present worth) for the once-through cooling water system was lower than that for the closed-cycle cooling tower systems by the amounts shown below:

System	Differential Cost (base year 1977)
▪ Once-Through System	-
▪ Round Mechanical Draft Cooling	$ 4,219,000
▪ Rectangular Mechanical Draft Cooling Tower	$ 5,112,000
▪ Natural Draft Cooling Tower	$12,049,000

It should be noted that the once-through circulating water system intake structure presented in Chapter II is a modified version of the intake structure evaluated in the engineering cost analysis. Subsequent modifications to the original intake structure have been made to further reduce the environmental impact of the structure on the aquatic ecology. These design modifications do not significantly affect the total generating cost developed for the once-through cooling water system.

iii. Conclusions

The once-through cooling water system has been chosen as the primary alternative for Neal Unit 4 based on analysis of environmental impact, aesthetics and engineering cost. The once-through system will have a minimal impact on the aquatic ecology, no impact on terrestrial communities and will minimize consumptive water loss. The aesthetic impact of the once-through cooling system will be negligible. In addition, the total generating cost (present worth) of the once-through system was lower than that for the closed-cycle cooling tower systems. Consequently, the applicant considered the once-through system to be the preferred condenser cooling water system for Neal Unit 4.

2. Intake Structure

Power plant intakes have traditionally been designed solely on the basis of satisfactory engineering design at minimum cost. However, with current attention directed toward the potential environmental effects of intake systems, these structures must be designed to minimize their environmental impact, while keeping the cost factors in proper perspective. In light of this, the EPA issued the "Development Document For Proposed Best Technology Available for Minimizing Adverse Environmental Impact of Cooling Water Intake Structures" (December, 1973) followed by final intake structure design guidelines as set forth in 40 CFR 402 (April, 1976).

The following alternative intake systems were considered for use at Neal Unit 4:

a. Lagoon System

This alternative would involve the construction of an offstream lagoon at the plant site. Offstream systems are discussed in the aforementioned EPA Development Document and are considered to be conducive to increased incidence of fish entrapment. This is the result of the attraction of fish to the still waters of the lagoon. A modified approach would be to install screens flush with the river bank at the inlet to the lagoon; however, this would entail increased operational problems to maintain both the screens at the intake structure and the additional screens at the river bank. Consequently, the lagoon alternative was rejected for use at Neal Unit 4.

b. Groundwater Intake

This alternative would involve the construction of a system of wells or Ranney collectors to provide the 317,400 gpm required for the once-through condenser cooling water system at the plant site. Because of the amount of land required for the installation of a sufficient capacity well/collector system and the reluctance to utilize a limited groundwater supply for condenser cooling water when there is a large flow available for such purposes in the Missouri River, the alternative was rejected for use at Neal Unit 4.

c. Slotted Pipe Intake

This alternative would involve the construction of slotted collecting pipes along the river bottom. Water would be drawn through these pipes to a concrete caisson and then passed through the Neal Unit 4 condenser. Because of the quantity of flow required for the once-through cooling water system and the necessity of designing a system that would not interfere with navigation on the Missouri River, a series of these slotted pipes would be required along the river bottom. However, because of the continuous shifting of river bottom elevation resulting from normal sediment transport and the potential future degradation of the Missouri River bottom due to the effects of channelization, this alternative was rejected for use at Neal Unit 4.

d. Shoreline Intake

This alternative would involve the construction of a conventional shoreline intake along the bank of the Missouri River. This alternative was selected for use at the Neal Unit 4 site.

A design study for a suitable intake system included selection of intake approach velocity to the traveling screens, design and location of the intake structure, trashrack design and selection of the traveling screens. For example, the approach velocity to the traveling screens should be as low as practicable to reduce fish impingement upon the screens and allow fish to swim away from the intake area. A balance had to be achieved between increased cost due to a larger intake required for lower velocities, and reduced fish entrapment. Recent studies have shown that intake approach velocities should be in the range of 0.5 fps to minimize injury to aquatic life.

In line with the above, the following criteria have been developed for the design of the Neal Unit 4 intake structure:

i. Intake Velocities

The velocity through the traveling screens will be about 0.7 fps with an approach velocity of about 0.3 fps during the navigation season. This season extends from about April 1 to December 1.

ii. Sand Weir

A vertical sand weir will be employed instead of one that is inclined along the trashracks (Units 1-3) in an effort to reduce crayfish entrapment.

iii. Screen Wash System

The screen wash system will consist of both high and low-pressure sprays. The low-pressure sprays will be used to remove any fish that may impinge on the screens to a trough where they will be sluiced back to the river at a point located downstream of the intake structure. High-pressure sprays will be used to remove trash from the screens to a separate debris trough for disposal back to the river.

A detailed description of the intake system is presented in Chapter II.

3. Chemical Waste Treatment System

The following waste streams will require treatment before discharge to be in compliance with the EPA Effluent Guidelines and Standards: boiler blowdown, demineralizer regenerants, filter backwash, floor drains and powdex wastes.

At Neal 4 chemical waste streams will be collected in various flow equalization basins. Waste water will be diverted from the basins through final treatment processes before discharge. The following treatment systems are capable of producing effluents meeting the applicable regulations:

- Evaporation
- Ultrafiltration
- Plain Sedimentation
- Flocculation-Clarification
- Sand Filtration

A description and evaluation of each alternative waste water treatment system follows.

a. Evaporation

This treatment alternative will produce an effluent essentially free of dissolved solids. The effluent would be suitable for reuse in the boiler makeup water supply system. Approximately 5-10 percent of the waste water stream, containing all the dissolved and suspended solids from the waste water, may require further treatment before disposal.

Evaporation systems require large capital and operation and maintenance expenses, and impose a large power penalty on the generating station.

b. Ultrafiltration

Ultrafiltration employs membrane filters for the removal of suspended solids. Ultrafiltration systems operate at relatively low pressures, 50 to 100 psig and produce a concentrated suspension of suspended solids for disposal.

c. Plain Sedimentation

Plain sedimentation is sufficient to effectively remove suspended solids from non-dissolved metal content wastes. This system is inexpensive in terms of capital and operation and maintenance costs.

d. Flocculation-Clarification

A flocculation-clarification system precipitates dissolved heavy metals and fine colloidal suspended solids by entrapment and sedimentation. To accomplish this a flocculating agent, lime and/or an organic polymer, is added and the waste water is slowly mixed to induce floc formation. The flocs formed are removed by sedimentation.

e. Sand Filtration

Sand filtration is a well developed technology with gravity and pressure filters in common use. For effective filtration close control of the hydraulic loading rate is necessary. Sand filters are well adapted for use where the TSS concentrations are relatively low, as high levels of TSS makes frequent backwashing necessary.

f. Comparison of Alternatives.

Based on the above, a flocculation-clarification system and plain sedimentation system were selected for use at the Neal 4 Station to treat heavy metal content wastes and non-dissolved metal content waste streams, respectively.

4. Sanitary Wastewater Treatment

For Neal Unit 4, the following sanitary wastewater treatment systems were considered:

- Discharge to a municipal treatment system
- Extended aeration activated sludge treatment
- Physicochemical treatment

The following is a brief description of each treatment alternative:

a. Discharge to a Municipal Treatment System

This alternative is not viable at the Neal 4 site as its use would require the installation of a 12 mile pipeline and a pumping station to reach the Sioux City, Iowa treatment plant.

b. Extended Aeration Activated Sludge Treatment

The extended aeration activated sludge process is an aerobic biological treatment system. It is ideally suited for use with discharge of raw wastewater because of its consistent treatment efficiency and low excess sludge production. This system incorporates an aeration basin where raw wastewater is put into contact with aerobic microorganisms. The microorganisms metabolize much of the dissolved and suspended organic solids. After sedimentation, the effluent would be discharged to a leaching field.

c. Physicochemical Treatment

Physicochemical treatment of sanitary wastes uses the unit processes of flocculation-clarification, for suspended solids removal, and carbon adsorption for removal of dissolved organics. This treatment system is overly expensive when applied to small systems, as the cost of chemicals, chemical feed equipment and operation and maintenance costs would be high.

d. Comparison of Alternatives

Based on the above, the extended aeration activated sludge system is the most viable alternative for both technical and environmental reasons. The use of a leaching field will result in no discharge of sanitary wastes to the Missouri River.

5. Liquid Discharges

The present plant system design directs all liquid discharges to the Missouri River. Alternatives to the present system which are under consideration are as follows:

a. Main Condenser Cooling Water Discharge

The possibility of modifying the design of the seal well to allow for a maximum of 20,000 gpm to be diverted to Snyder Bend is under consideration at the request of the Corps of Engineers. The discharge would be directed to the Corps of Engineers' inlet channel and be used to maintain the level of the Snyder Oxbow Lake for the proposed Snyder-Winnebago recreational area. Should this alternative in the future prove beneficial to the development of the proposed park, then an application for the necessary discharge permit would be made at such time.

The U.S. Army Corps of Engineers issued a Notice of Permit Pending on September 30, 1976, concerning an application by the Woodbury County Conservation Board for a Department of the Army Section 404 permit to dredge about 21,600 cubic yards of sediment from Snyder Bend Lake.

In a November 4, 1976 letter to the Corps, EPA made the following comments with regard to the proposed dredging:

- Dredging procedures which may disturb the suspended solids and turbidity levels in the lake must be investigated for potential impacts to be incurred by water supply intakes and other activities. Sufficient notice must be given to owners of affected activities in order to prepare for changes in water quality.

- Measures aimed at preventing or controlling spilled fuels or lubricants from entering the lake or river must be employed. A contingency plan is required to be effective in the event of a spill.

- A program for immediate removal of debris during construction must be established and implemented.

- Deposition of excavated materials on shore and earth work operations must be carried out so that sediment runoff and soil erosion to the river are controlled.

- When dredging activities are completed, fills on shore and other disturbed areas are required to be seeded, riprapped, or protected in other ways to prevent soil erosion.

b. Auxiliary Cooling Water Discharge

The possibility of redirecting the cooling water discharged from the auxiliary heat exchangers and coolers to Browns' Lake State Park is under consideration at the request of the Iowa State Conservation Commission. The total discharge of approximately 6,800 gpm would be used to maintain the level of the lake. An alternate discharge line would be provided to divert the cooling water to the seal well when high water levels occur in Browns Lake. Should this alternative in the future prove beneficial to the management of the park then an application for the necessary discharge permit would be made at that time.

The most recent information regarding the project is included in the Environmental Assessment for the Brown's Lake Restoration Project prepared by Iowa State Conservation Commission in 1976.

The following impacts which may result from the implementation of the project will require further study prior to issuance of a NPDES permit for the discharge to Brown's Lake.

- Construction activities will involve increases in fuel consumption, noise levels, fugitive dust, and smoke. Various degrees of both soil erosion and compaction will occur. Minimal impacts to local traffic should result. Temporary disturbance and displacement of wildlife can be expected. Vegetation in the "dry" marsh area will be destroyed at and near the construction site.

- The proposed increased water level in Brown's Lake should increase the water surface area from about 200 to 580 acres. This level will conform closely to the "ordinary high water mark" of the lake. The "dry" marsh area, therefore, will become "wet" marsh, which should result in more intensive use by certain wildlife species. However, other animals, especially upland species requiring nesting cover, will lose their habitat, resulting in local losses in their populations.

Inundation will affect the amount of tree cover in marsh and transition areas. Continuous flow of water through the ditch will alter the types of vegetation in the low-lying areas. However, operation of the ditch should not impose constraints on existing land use.

- Thermal pollution to the lake as a result of discharging cooling water may affect certain species of aquatic biota. The timing and quantity of water released to Brown's Lake will be controlled to minimize any adverse environmental impact.

- Sedimentation resulting from the existing suspended materials to be introduced to the lake by discharging cooling water may affect the water quality of the lake. Deposits of sand and silt in Brown's Lake will occur, however, the timing and quantity of water released to the lake will be controlled to minimize any adverse environmental impact.

- Operational impacts to be incurred by the lake include minor increases in fuel consumption and air and water pollution resulting from flat-water sports, especially motor boating. Traffic congestion, possible trespass by potential users, and soil compaction and erosion may occur as a result of intensive usage. Increases in solid waste production will result.

c. Coal Pile Runoff

Coal pile runoff will be treated as required to meet New Source Performance Standards (NSPS) effluent limitations and then directed to the Missouri River. As in the case of the condenser cooling water, should an application be made in the future for a permit to discharge water into Snyder Bend, then the potential inclusion of treated coal pile runoff in that discharge would be evaluated at that time.

6. Air Quality Control System

a. Introduction

For a coal-fired electric generating station, such as Neal Unit 4, air quality control techniques are applied to limit the emission of polluting combustion products into the atmosphere, and to utilize the potential of the atmosphere to dilute those air pollutants that are emitted. The effectiveness of these techniques can be measured, respectively, in terms of compliance with the Federal New Stationary Source Performance Standard (40 Code of Federal Regulations 60) and the National Ambient Air Quality Standards (40 Code of Federal Regulations 50). An evaluation is made in this section of the applicability of various techniques to remove sulfur dioxide (SO2), oxides of nitrogen (NOx) and suspended particulate matter from the flue gas and of the suitability of a major boiler stack parameter; i.e., height.

b. Sulfur Dioxide Control

The typical coal evaluated in Chapter IV has a heating value of 8125 Btu/lb and a sulfur content of 0.478 percent or less. Hence, compliance with Federal emission standards can be realized without the need for SO2 removal equipment. However, space is being provided so that SO2 removal equipment can be installed in the future, if required by changes in coal characteristics or regulatory standards.

c. Oxides of Nitrogen Control

Compliance with Federal emission standards for NOx is effected by efficient operation of the boiler. Stack monitoring of NOx emissions and the manufacturer's furnace guarantee provide additional assurance that Neal Unit 4 will meet the above standards. Present state-of-the-art removal of NOx from the flue gas is economically unfeasible. The Environmental Protection Agency has stated that combustion additives are ineffective as a control measure. Therefore, no feasible alternative NOx control technique exists at the present time.

d. Particulate Matter Control

In Section II-B-4, reasons were given for the selection of a hot-side electrostatic precipitator for Neal Unit 4. The alternative particulate matter control devices include cold-side electrostatic precipitators, mechanical collectors, baghouse filters, wet scrubbers and various combinations of these devices.

i. Electrostatic Precipitator

Cold-side and hot-side electrostatic precipitators have identical principles of operation (see Section II-B-4). However, the latter is placed at the "hot" side (inlet) of the combustion air heater while the former is placed at the "cold" side (outlet) of the combustion air heater. Since the boiler flue gas cools as it heats the combustion air, the cold-side precipitator experiences flue gas temperatures in the range of 250 to 300 F. At these temperatures the chemical properties of the flue gases and suspended particles play a significant role. Sulfur and moisture exhibit appreciable influence on particulate resistivity. When sulfur content is low (up to 2 percent) resistivities in this temperature range are generally higher than the critical value of 10^{10} ohm - cm and electrical operation becomes unstable. Frequent sparking could occur and it may be difficult to achieve reasonable efficiencies.

The advantages of the cold-side precipitator are that construction materials need only withstand moderately low temperatures and volumetric requirements for a given mass flow of the flue gas which are considerably less than for a hot-side precipitator. Since Neal Unit 4 is a new plant, and since materials technology is sufficiently developed, these advantages cannot outweigh the previously mentioned characteristics of a hot-side precipitator.

ii. Mechanical Collector

Mechanical collectors are utilized extensively, primarily to remove relatively large sized particles. Mechanical collectors can collect approximately 70 to 80 percent of fly ash in flue gases produced by modern pulverized coal-fired steam generators. Such low collection efficiencies are not adequate to comply with emission regulations. However, this does not preclude the consideration of mechanical collectors in conjunction with other more sophisticated emission control devices, such as precipitators, in order to minimize associated problems with such devices.

iii. Baghouse Filter

The baghouse filter is the oldest method of dust removal. The principle of particle removal is simply to filter particulate laden gas through a fabric which retains the particle and allows the cleaned gas to proceed on through. The fabric filter collector is capable of providing a high collection efficiency for particles as small as 0.5 microns. The limitation in the applicability of this collection technique is dependent upon the chemical and physical properties of the fabric materials, and "caking" associated with hygroscopic properties of some particulate substances.

The primary limitation of baghouse filters corresponds to the existence of a large amount of moisture. Condensation, occurring inside the collector, will foster the buildup of a wet cake on the fabric filter surfaces, increasing the resistance sufficiently to curtail gas flow. The cohesive properties of a "mud-like" cake impair removal of particulate buildup employing ordinary design methods. The bags must be removed, washed, and dried. Frequently, under these conditions, the bags will shear.

Some particulate substances are hygroscopic and build up excessively on the bag surfaces when inconspicuous amounts of moisture are present in the flue gas.

There is concern about the effects of the sulfur dioxide and moisture content in the flue gas. This combination is conducive to creating conditions which can shorten fabric life. Other parameters taken on a large scale basis, such as bag cleaning, resistance profile, etc., which are significantly related to fly ash characteristics, have not been established.

These uncertainties, combined with the lack of any widespread utilization by electric utilities, must restrict the use of baghouse filters to special AQCS retrofit operations.

iv. Wet Scrubber

Wet scrubbing involves washing the fly ash laden flue gases with a liquid, usually water. Wet scrubbers provide for intimate contacting between the flue gas and the scrubbing liquid in such a manner that the particulates are transferred from the flue gas to the liquid and removed as a liquid effluent.

The most common type of scrubber is the venturi. The venturi design uses the kinetic energy of the flue gas to shear the curtain of liquid that converges with the high velocity flue gas at the throat section. The scrubbing liquid can either be injected at the throat section or at the top of the converging section.

To achieve at least 99 percent fly ash collection efficiencies, pressure drops on the order of 10 to 12 inches of water (gauge pressure) are required. To achieve 99 plus percent collection efficiencies, pressure drops ranging upward from 12 inches of water (gauge pressure) to 20 inches of water (gauge pressure) may be required. Exact operating pressure drop depends upon the gas flow rate and the quantity of scrubbing liquid injected into the scrubber. The liquid flow rate nominally used is 15 to 20 gal per 1000 absolute cubic feet per minute (ACFM) of flue gas. Saturation conditions (temperature and gas density) in conjunction with the quantity of scrubber liquid determine the precise pressure drop.

Fly ash scrubbing will also result in the removal of sulfur dioxide from the flue gas. Different fly ashes possess different alkalinity properties. Scrubbing units recirculating a high alkaline fly ash have resulted in sulfur dioxide removal efficiencies as high as 50 percent. Such removal requires special materials of construction. Also depending upon the locality, the bleed liquid from the recycle scrubbing liquid may require neutralization before being transmitted to the existing water treatment facilities.

The major factors in excluding wet scrubbers are larger operating power requirements to overcome the relatively high pressure losses, potential water quality problems requiring additional intake water and water treatment facilities, potential clogging, corrosion or abrasion problems which would affect system reliability and economic cost.

v. Boiler Stack

The potential of the atmosphere to dilute air pollutant emissions depends on meteorological conditions, topography, and boiler stack height. Computation of pollutant ground-level concentrations, presented in Section IV-C, shows that the 469 foot Neal Unit 4 stack is adequate to meet ambient standards. A taller boiler stack would permit greater dilution of the pollutants emitted from the stack and thereby lower ground-level concentrations. However, due to its proximity to the Sioux City Municipal Airport, the Neal Unit 4 boiler stack cannot be increased from its proposed height of 469 feet; this limit has been established by the Federal Aviation Administration.

7. Solid Waste Storage and Disposal

Neal Unit 4 will utilize an approximate 114 acre solid waste disposal area to provide storage for plant generated sludge and ash. Operational procedure will include alternating layers of waste material with layers of soil to provide the potential for reclamation of this area at some future date. Provisions will be made at the solid waste disposal area by use of water trucks to minimize fugitive dust emissions.

Alternatives to this sytem and the reasons for their rejection are presented below:

a. Wet Storage Ponds

Consideration was given to providing for storage of plant generated ash and sludge in wet disposal ponds. The area required for these ponds would be similar to that required for the solid waste disposal area. Inherent in the use of a wet system is the increase in plant consumptive water use to satisfy sluice water requirements. In addition, blowdown from the bottom ash and sludge ponds would require treatment to meet NSPS effluent limitations prior to discharge back into the river and fly ash sluice water could not be discharged. Consequently, for these reasons the wet storage pond system was judged to be less acceptable, both from an environmental and an engineering viewpoint, than the solid waste disposal area.

b. Off-Site Disposal

Consideration was given to providing for total or partial off-site removal of solid waste (ash) by an independent contractor for marketing purposes. Unfortunately, at the present time no firm market exists for utilization of the ash generated by Neal Unit 4. However, should conditions improve in the future, this alternative would be explored further.

8. Lining of Major Storage Areas

a. Coal Storage Area

Initial investigation of a coal storage area lining at Neal Unit 4 indicated that the capital cost of either a stabilized lime-fly ash or a high density polyethelene membrane lining would be about $2,000,000. Because the coal storage area is designed so that rain water will predominately run off the coal pile and will be transported by a ditch system to a holding pond, the excessive cost associated with the installation of a lining under the coal storage area was not deemed justified.

Preliminary tests of coal pile runoff at the existing station indicates basic pH characteristics. It is the intention of Iowa Public Service Company to conduct ground water quality monitoring underneath the existing station coal pile and a control station prior to establishing the location of the Neal Unit 4 coal pile.

b. Coal Runoff Holding Pond

Based on the preliminary analysis of the coal from the Red Rim area proposed for Neal Unit 4 (Section II-B-4), the low sulfur characteristic of the coal indicated a high calcium content that will result in a high pH of any runoff water entering the holding basin. This is supported by field data obtained from studies at Neal Unit 3 indicating pH values of 7-9. The combination of this high pH runoff and the long detention time in the holding pond would result in the precipitation and sedimentation of materials in the runoff. In addition, this effluent would be further treated in the wastewater system prior to discharge. Based on the projected runoff characteristics, the approximate cost of $500,000 and the fact that a lining could be installed at a later date if it were deemed necessary, no lining will be installed at the present time.

c. Solid Waste Disposal Area

The lack of deleterious environmental impacts associated with the waste disposal areas at Neal Units 1-3, combined with the excessive cost (approximately $5,000,000) associated with the alternative of lining under the solid waste disposal area, resulted in a decision that a lining in this area was unnecessary and uneconomical.

9. Fuel Supply

The primary source of coal for Neal Unit 4 will be the Red Rim area of Sweetwater and Carbon Counties in Wyoming. A letter of intent has been signed with the Rocky Mountain Energy Company, a subsidiary of Union Pacific Corporation, to develop a plan for a joint mining venture with Centenial Coal, Inc., a subsidiary of Iowa Public Service Company. Negotiations for a formal agreement are in progress.

An alternative source of coal for Neal Unit 4 could be from mines in the Hanna, Wyoming area. Three mines in this area are currently under long-term contracts to supply fuel for Neal Units 1-3. Typical characteristics of the coal from this area were presented in Chapter II. Since the Neal Unit 4 boiler will have the capability to burn coal with a wide variation in characteristics, the potential for supplying Neal Unit 4 from mines in the Hanna area, or subsequently from mines in other areas, could be investigated should difficulties arise in the negotiations for the Red Rim area.

In all cases, the mining operations would comply with all existing regulations such as those set forth by the State of Wyoming, U.S. Bureau of Land Management (43 CFR 3041), U.S. Geological Survey (30 CFR 211) and the U.S. Environmental Protection Agency (40 CFR 434). The Energy Development Company, which will operate the Neal 4 mine, follows operational procedures which involve the leveling of stripped areas and replacement of topsoil followed by reseeding of all areas with local grasses. During five years of mining in this area, the Energy Development Company has disturbed about 300 acres. Approximately 90 percent of this area has already been reclaimed or is in the process of being restored from wasteland to valuable grazing land.

D. ALTERNATIVES TO NORMAL MODE OF OPERATION FOR MINIMIZING ENVIRONMENTAL IMPACT

EPA is concerned about the loss of larval fish via condenser and plume entrainment resulting from George Neal Station. At certain flow rates in the river and at full power large numbers of larval fish will be killed which may cause significant and measurable adverse impacts on the Missouri River ecosystem.

As indicated in Chapter III, there is a difference in the larval fish population reported at the existing George Neal facility from that reported at Omaha Public Power Districts, Fort Calhoun Station. It is acknowledged that there are geographical differences and differences in the time of data collection, however, it is EPA's opinion that data collected at Fort Calhoun may represent the larval fish population in this section of the Missouri River.

Because of the difference in estimated larval fish population, and the somewhat uncertainty of the source of recruitment of larval fish downstream of George Neal Station, several studies will be conducted to lead to a selection of possible alternative modes of operation. If data becomes available to show that the proposed operational mode will indeed result in significant adverse impact, EPA may recommend that one of the following alternative modes of operation be adopted to minimize the impact:

- Adjust power generation of Neal Unit 4 with resultant reduction of cooling water flow, during the time of larval fish passage to adequately reduce the environmental impact. Any adjustment could be keyed to those species of fish which potentially would be most severly impacted. For example, the peak entrainment time for walleye and sauger occurs in May (Ft. Calhoun data). It is possible a reduction in cooling water flow during this time would reduce the impact of plant operation.

- Modification of the daily operational procedures of the plant to retain its daily peaking ability, but reduce power output during other times of the day to reduce entrainment losses.

Detailed studies by the applicant to identify the areas of spawning and recruitment along with additional documenting of the species composition and numbers of local fish entrained may lead to a conclusion that no operational modifications are necessary. However, based on the information available at this time, the above alternatives or other modifications described in this chapter will be evaluated to minimize impact.

CHAPTER VI

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

A. INTRODUCTION

The term "local short-term uses" of the Neal Unit 4 site refers to the period of plant construction and operation (about 30 years). The term "long-term productivity" refers to the environmental resource development potential through the lifespan of the proposed plant and beyond. Short and long-term impacts, both beneficial and adverse, may be associated with the use of the Neal 4 site.

B. SHORT-TERM USES

1. Beneficial Impacts

A short-term benefit of the expansion of the George Neal Steam Electric Station will be the creation of generating capacity adequate to meet the electrical power needs of the owner utilities, Mid-Continent Area Power Pool Members and Mid-Continent Area Reliability Coordination Agreement Region (see Chapter I). This augmented supply of electrical energy would be available throughout the service area to the public as well as for industrial, commercial, agricultural, public service, and recreational use. With the proposed capacity, Neal Unit 4 will provide greater system reliability and a reduction in the duration and extent of possible system disturbances.

Additional short-term benefits can be anticipated during the construction phase. These include the creation of new jobs, the expansion of local commerce and other related secondary economic activities. Also, a growth in the local tax base will be generated directly from the expanded facility because of increased payrolls and business activity. On the basis of current tax rates, Neal Unit 4 will represent $6,300,000 annually apportioned to 36 counties and 400 school districts and townships.

2. Adverse Impacts Which Cannot be Avoided

Environmental impacts which are likely to result from the short-term use of the Neal Unit 4 site have been identified in Chapter IV. These impacts must be traded-off in the short-term in order to realize the beneficial effects of the proposed plant. However, in most instances, measures are being taken to reduce environmental impacts to minimal levels well within the applicable standards of federal and state regulatory agencies. Systems, including those used for dust control, water and wastewater treatment and air quality control are expected to mitigate environmental impacts.

a. Water Quality

Neal Unit 4 will produce a certain amount of thermal (Section IV-B-2), chemical (Section IV-E), solid and sanitary wastes (Section IV-D). The regulations set down by appropriate state and federal agencies limit the release and concentration of these wastes. As presented in Chapter IV, no adverse impact on the balanced indigenous aquatic populations is expected as a result of discharges into the Missouri River.

b. Air Quality

Emissions of air contaminants and occurrences of ground level concentrations due to the operation of a coal-fired power plant such as Neal Unit 4 can be reduced, but not completely prevented, by air quality control systems (Section IV-B-4). However, both emission rates and ambient concentrations are expected to be within the applicable federal and state standards established to protect the environment from known and anticipated adverse effects, allowing a reasonable margin of safety. Therefore no significant adverse effects on air quality are expected.

c. Vegetation and Wildlife Habitat

The short-term impact of Neal Unit 4 on the terrestrial biota will be to remove a portion of the riparian shrub, winter browse and agricultural land serving as habitat and food sources for the many wildlife species inhabiting the area. If the Snyder-Winnebago Recreation Area is instituted, the land immediately south of Neal Unit 4 will remain a productive habitat for these wildlife species throughout the life of the plant.

d. Aquatic Ecology

The probable adverse effects of operation of Neal Unit 4 which cannot be avoided include:

i. Impingement of fish on the intake structure resulting in damage or death.

ii. Entrainment of planktonic organisms into the circulating water system, resulting in damage or death.

iii. Entrainment of planktonic organisms and fish in the thermal plume, resulting in damage or death.

Though mortalities of biota can be expected, the impact on the aquatic ecosystem will not be measurably significant.

e. Land

An adverse environmental effect on land use would be the withdrawal of the 450 acre Neal Unit 4 site from agricultural use. Since this acreage is minimal (less than 0.1 percent) compared to the total agricultural land available in Woodbury County, it is not expected to present serious problems. Visual impact of the plant complex from the potential Snyder-Winnebago Recreation Area is probable. Opportunities for mitigating the visual impact are being instituted through landscaping and planting procedures at key locations on the site.

It is not expected that serious socio-economic problems will be encountered in the surrounding area. Since the major construction work force is expected to come from the Sioux City area, social service impacts upon the local community will be minimal.

C. LONG-TERM PRODUCTIVITY

The maintenance of the resources described below has been dealt with in the previous chapters of this report. In this section questions concerning their potential for long-term productive use are discussed.

Maintenance of long-term productivity potential seems acceptable especially in the areas of thermal discharge into the Missouri River, aquatic biota, and ambient air quality since Neal Unit 4 must comply with applicable state and federal regulations.

To maintain long-term productivity of wildlife habitats and recreational use in the area, Iowa Public Service has a Wildlife Management Agreement with the Iowa Conservation Commission. This agreement sets aside several small areas totaling approximately 65 acres in the area surrounding the George Neal Station which are reserved for wildlife nesting and winter cover area. Food plot areas are left for winter feed from the farming operations on lands of Iowa Public Service. Public hunting is allowed on lands under the Wildlife Management Agreement. In addition, Iowa Public Service, with the cooperation of the Iowa Conservation Commission, has planted more than 30,000 trees in a buffer zone which will also provide wildlife habitat at the Neal 4 site. This buffer zone is approximately 110 ft. wide and runs along the highway separating the Neal 4 site from Brown's Lake and along the property line separating the Neal 4 site from the Snyder Bend park area.

The Neal Unit 4 site includes about 114 acres for storage of plant-associated solid wastes. This acreage is sufficient for the life of the plant.

Since the Port Neal Industrial District is presently zoned and developed for industry, land use is consistent with present policy and this is not anticipated to change in the future. Through replacement to meet demand, long-term productivity of regional resources, dependent upon electric power, is expected to continue long after the projected life of Neal Unit 4.

CHAPTER VII

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

A. GENERAL

Construction and operation of Neal Unit 4 will result in the irreversible and irretrievable commitments of natural resources. These resources will either be totally exploited or altered to the extent where their restoration would be impossible.

B. FUEL

The coal used to operate Neal Unit 4 represents a principal irreversible commitment of natural resources. After burning, the major constituents of the coal will be bottom and fly ash. These constituents have been altered greatly from the fossil fuels they once were.

During the 30-year life of the plant, approximately 50 million tons of coal will have been committed and irreversibly changed, based on projected capacity factors. This represents 0.012 percent of the coal reserves in the United States.

C. LAND USE

1. Power Plant Site

Land resources used for agricultural purposes prior to the construction and operation of Neal Unit 4 will be eliminated. A total of 450 acres of land will be converted from agricultural to industrial usage, and wildlife habitat in those areas are to be landscaped with "shelterbelts." In view of changing development trends, zoning, and the availability of relatively inexpensive energy, it is doubtful the land committed to the plant will revert back to agricultural production after Neal Unit 4 is decommissioned. Therefore, for all practical purposes, the agricultural productivity has been irretrievably lost.

2. Coal Mining Area, Wyoming

The overburden will be irreversibly altered by disturbance and replacement. These changes will affect the physical stratification, density, and compaction of the topsoil. The terrain will be altered, potentially resulting in changed drainage patterns.

3. Other

The increased power generated by the project may result in other irreversible changes in land use from new commercial or private development. This development is unpredictable and cannot be quantitatively evaluated in this statement.

D. WATER

The cumulative loss of water in the Missouri River basin over the 30-year life of the project will be about 600 acre feet, resulting from evaporation of heated water in the discharge and evaporation from the retention ponds. This will be a continual incremental loss of water during operation.

According to present knowledge, trace elements carried in the coal pile runoff and discharged into the Missouri River will have an irreversible impact on the river's ecosystem since it is not practical for these elements to be retrieved. The elements may precipitate to the river floor or be suspended and transported downstream. Whichever is the case, these elements are new additions to the ecosystem which would not be present under existing conditions.

The runoff from mining sites will be altered and will irreversibly change the character of receiving bodies of water (e.g., changes in pH and trace metal constituencies).

E. CONSTRUCTION MATERIALS

Except for materials which can be salvaged and recycled, most man-made resources will be irreversibly lost or altered to the extent that their use has been limited. These materials include steel, aluminum, copper, zinc, lead items, oils and fuels, and concrete.

F. LABOR AND MANPOWER

During the 3 1/2-year period of construction, an irretrievable commitment of human resources will be made. Approximately 25,900 man-months of labor will be employed by an average of 700 workers. This labor is needed to engineer, construct and operate Neal Unit 4.

CHAPTER VIII

COORDINATION WITH OTHERS

A. CONTACTS MADE BY APPLICANT

The following federal, state, county and local agencies and individuals were contacted by the applicant concerning the proposed plan for construction and operation at Neal Unit 4:

U. S. Environmental Protection Agency Region VII
Kansas City, Missouri

U. S. Corps of Engineers, Omaha District
Omaha, Nebraska

Federal Aviation Administration
Kansas City, Missouri

Iowa Department of Environmental Quality
Des Moines, Iowa

Iowa Natural Resources Commission
Des Moines, Iowa

Iowa Conservation Commission
Des Moines, Iowa

Iowa Commerce Commission
Des Moines, Iowa

Nebraska Department of Environmental Control
Lincoln, Nebraska

Woodbury County Health Department
Sioux City, Iowa

Woodbury County Board of Supervisors
Sioux City, Iowa

Woodbury County Conservation Commission
Sioux City, Iowa

Woodbury County Planning & Zoning Commission
Sioux City, Iowa

Mayor & Council, City of Salix
Salix, Iowa

Mayor and Council, City of Sioux City
Sioux City, Iowa

Siouxland Interstate Metropolitan Planning Council
Sioux City, Iowa

Mr. Ted Hoffman, Nebraska Chapter
Sierra Club,
Omaha, Nebraska

Sioux City Chapter Izaak Walton League
Sioux City, Iowa

Mr. George Wimmer
Sioux City Industrial Development Council
Sioux City, Iowa

Sioux City News media

B. MEETING WITH ENVIRONMENTAL GROUPS

On July 8, 1976, the U.S. Environmental Protection Agency, U.S. Corps of Engineers, Rural Electrification Administration and Iowa Public Service Company held a meeting with some of the Sioux City area environmental groups. Representatives from the Sierra Club, Izaak Walton League, and Woodbury County Conservation Board were present at the meeting. Representatives from the League of Women Voters and the Audubon Society were invited but did not attend. The purpose of the meeting was for the agencies to receive input and information concerning Neal Unit 4 in the early preparation stages of the impact statement.

Environmental issues such as water and air quality, land use, and wildlife impacts were explored. The EIS process was explained and discussed. Another important issue discussed at the meeting was possibility of discharging cooling water into Brown's Lake and Snyder Bend. It was stated that due to the differences in the lakes' characteristics compared to those of the discharges, they would have to be assessed as separate discharges from the discharge into the Missouri River. This would require a new NPDES permit and a separate environmental evaluation.

C. PUBLIC INFORMATION MEETING

On August 25, 1976, EPA and the Corps held a public information meeting wherein all citizens were invited to comment on the project and/or the EIS preparation process. News releases and public service announcements were used to publicize the meetings.

In attendance at the meeting were representatives from the Federal agencies, power company, news media, environmental groups, and concerned citizens.

Topics of the meeting included type and degree of water pollution, possible usage of cooling water to upgrade Brown Lake and Snyder Bend, schedules for Neal Unit 4, and explanations and rationales for the various permits required for the construction and operation of the power plant.

No controversies or objections to Neal Unit 4 surfaced at the meeting.

CHAPTER IX

WRITTEN COMMENTS RECEIVED

AND

ENVIRONMENTAL PROTECTION AGENCY RESPONSES

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER 76/1021

DEC 10 1976

Dear Mr. Svore:

Thank you for your letter of October 12, 1976, transmitting copies of the Environmental Protection Agency's draft environmental impact statement for the George Neal Steam Electric Generating Station, Unit 4, Woodbury County, Iowa.

Our comments are presented according to the format of the statement or by subject.

General Comments

We note from Exhibit 1-A-2 that the project is approximately one-third complete. As a result, many decisionmaker options have been foreclosed and the utility of an environmental statement at this point in project development greatly reduced. Especially significant is the elimination of opportunities to implement the alternatives discussed in Chapter V with the exception of those mentioned in section D. For example, further consideration of alternate plant sites and alternatives to a once-through cooling system are precluded.

Outdoor Recreation

The environmental statement should recognize that the "Browns Lake (Bigelow Park)" briefly described on page III-105 has received matching assistance from the Land and Water Conservation Fund for the development of public recreation facilities. Although it appears that no land will be taken from this park, the applicant should be aware that this area is subject (in its entirety) to the provisions of Section 6(f) of the Land and Water Conservation Fund Act, as amended. This section of the Act requires that changes from the recreational use of the land be approved by the Secretary of the Interior.

We suggest that the noise impact on recreation on and around Browns Lake during construction be evaluated. In addition, the statement should include a non-technical discussion of the noise impact of plant operation on both the Snyder Bend and Browns Lake recreation areas. The discussion on page IV-92 suggests that the noise level in the Snyder-Winnebago Bends Recreation Area will substantially exceed the maximum noise level found to permit residential outdoor enjoyment. Therefore, the conclusion on page IV-93 that plant operation ". . . should not have a significant adverse noise impact on the surrounding area" seems unwarranted.

The statement should evaluate impacts on the vegetation, wildlife, and water quality in nearby recreation areas resulting from atmospheric emissions. Where scientific knowledge is inadequate to make accurate predictions, estimates should be given based on observations of impacts resulting from emissions from Neal Units 1-3.

Also, we believe that the final environmental statement should include a discussion and worst condition analysis of the cumulative impact of noise, visual intrusion, and atmospheric emissions of all four Neal Units and the transmission line on the continued recreational utility of the Browns Lake and Snyder-Winnebago recreation areas.

Information presented in the statement contradicts the conclusion on page V-12 that "the proposed activities would be compatible with the present land use practice of the area." Noise, aesthetic, and air quality impacts on nearby parklands appear to be significant and are in need of a more complete evaluation.

Historic and Archeological Sites

It is unclear from the discussion on page III-102 whether the cultural resource survey undertaken in May, 1973, included the proposed George Neal Steam Electric Generating Station, Unit 4, as well as the proposed Snyder-Winnebago Bends Recreation Area. In the event that the 1973 inventory included the Unit 4 project area, the statement should provide detailed information concerning the inventory and analysis of cultural resources within the affected area, including a description of the survey methods utilized and extent of archelolgical testing. Complete coverage of the entire project area including access roads and transmission facilities by a professional archeologist is necessary.

Copies of correspondence with the State Historic Preservation Officer (Mr. Adrian Anderson, Division of Historic Preservation, B-13 MacLean Hall, Iowa City, Iowa 52242) and the State Archeologist (Dr. Duane C. Anderson, 21 MacLean Hall, University of Iowa, Iowa City, Iowa 52242) should be included within the statement. The statement should further reflect procedures to be followed should previously unknown archeological resources be encontered during project development.

Fish and Wildlife

We understand that the best possible methods will be used so that impingement on aquatic life will be kept at a minimum. This is commendable but it is quite certain that the entrainment will be of a greater magnitude than that described in the draft environmental statement. Species composition of fishes found at other Missouri River generating stations do not compare favorably with data gathered for the George Neal Station. A fair job has been done in qualifying the fishes that will be lost during the once-through cooling process; a poor job has been done in quantifying these losses. Numbers of fishes are of little use for entrainment studies when these numbers are not correlated with volumes of water sampled. The draft environmental statement should identify the problems of entrainment in a more definitive manner and describe what is to be done to lessen the impacts resulting from this type of cooling process. Two methods of mitigating the losses could be considered. One is to limit the velocities of water withdrawn and a second is to limit the times that the water is withdrawn both seasonally and diurnally. Potential mitigating measures of this nature should be discussed in the final statement.

Lining of Storage Areas

We are concerned that seepage from the ash disposal area and the coal storage area will contaminate the groundwater. Page V-44 indicates that linings under the coal storage area and the solid waste disposal area are not considered necessary.

Likewise the liner for the coal runoff pond will not be installed at this time but will be considered later, if necessary. Little information is provided in the draft statement to support these decisions. More detailed justification for the conclusions should be given in the final statement.

A proper analysis of the impacts of leachates from the ash ponds should be provided. The suggested use of data from existing ash ponds seems appropriate if similar coals have been used in the existing units; we believe, however, that data to be used should include information on effects on the ground water beneath the existing ash ponds in order to provide a firm basis for anticipating or predicting effects. The ground water impact analysis should also include consideration of effects from infiltration of chemicals from the retention ponds A and B discussed on page II-35.

Monitoring programs to determine the impacts on groundwater in the ash disposal and coal storage areas should be described in the final statement with specific indication of the mitigating measures the applicant is prepared to implement if contamination of the ground water is significant.

Solid Waste Storage and Disposal

In the discussions on page V-43, we do not understand the rationale of storing the ash and sludge on-site and alternating layers of waste material with layers of soil to provide a potential for reclamation of this area "at some future date." The procedures employed for potential reclamation along with any specific plans for reclaiming the area should be discussed more fully.

Water Quality Monitoring Stations

Water-quality monitoring of the river below the proposed plant should be considered. This would permit assessment of any adverse effects resulting from the combined wastewater discharges. The discussions on pages III-24 to 27 appear to indicate that no monitoring stations will be located below Unit 4.

Cumulative Impacts

No mention is made of the cumulative impacts of the various generating stations along the Missouri River although Section VII-D does mention the cumulative loss of water in the Missouri River due to this project. There are, for instance, fifteen generating stations along a 360 mile stretch of river from Sioux City to Kansas City. Each plant is not an entity apart from the others when the same air and the same body of water are shared. As future additions are made to the power generating facilities in this area, cumulative impacts will become increasingly important. Recognition of this situation should appropriately be given in the final statement with some indication of its current significance.

Sincerely yours,

Stanley D Doremus

Deputy Assistant Secretary of the Interior

Mr. Jerome H. Svore
Regional Administrator
Environmental Protection Agency
Region VII
1735 Baltimore
Kansas City, Missouri 64108

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGION VII
FEDERAL BUILDING
601 EAST 12TH STREET
KANSAS CITY, MISSOURI 64106

OFFICE OF
THE REGIONAL DIRECTOR

November 24, 1976

Mr. Jerome H. Svore
Regional Administrator
U.S. Environmental Protection Agency
Region VII
1735 Baltimore
Kansas City, Missouri 64108

RE: Draft Environmental Impact Statement
George Neal Steam Electric Generating Station
Neal Unit 4

Dear Mr. Svore:

Thank you for the opportunity to review the above referenced document and to comment on it's impact on responsibilities and interest of the Department of Health, Education and Welfare.

In the specific area of "Impact on Local Socio-economics" starting on p IV-1 it is indicated that the Neal Unit #4 will have a construction schedule of approximately 3½ years with a projected average construction workforce on the site of 700 to a maximum of 1200 workers. Further it is estimated that it will require an estimated 100 to 700 workers with an assumed average family size of 3.1 persons relocating to Sioux City area during various periods of construction. It is conceded that not all workers will relocate their families and that the maximum population increase in Sioux falls and vacinity is expected to be 1.8% of the total population. Based upon this, the conclusion is drawn that "construction worker immigration should have little, if any adverse impact on housing and social services in the area."

Data which is presented in the document would in part bear out this conclusion as far as housing is concerned however, there does not appear to be any data presented as to the types, numbers, or case loads of social services or the numbers and types of community facilities and services, including health, from which a valid conclusion can be drawn relative to impact on "social service".

Demographic information is presented in the document to show the ambient state of the population in the area effected. Such information and data should also include existing community facilities and services and other community resources which are utilized by the existing population with discussion in the final EIS on the effect that the proposed project has upon the services rendered.

Further, there should be some discussion to assure that adequate drainage will be provided to borrow areas and construction sites to reduce or eliminate ponding of water and thus the enhancement of vector control in the area.

Sincerely

William H Henderson
William H. Henderson
Regional Environmental Officer

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION SEVEN

P. O. Box 19715
Kansas City, Missouri 64141

November 4, 1976

IN REPLY REFER TO:

07-00-ED

Mr. Jerome H. Svore
Regional Administrator
U.S. Environmental Protection Agency, Region VII
1735 Baltimore
Kansas City, Missouri 64108

Dear Mr. Svore:

The Draft Environmental Impact Statement for the George Neal Steam Electric Generating Station, Woodbury County, Iowa, has been coordinated with the Office of the Secretarial Representative, DOT, and the Statement adequately considers the effect the project may have on road systems within the jurisdiction of the Federal Highway Administration.

Sincerely yours,

Steiner M. Silence

Steiner M. Silence
Director, Office of Environment & Design

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS
COMMANDER (dpl/eis)
SECOND COAST GUARD DISTRICT
FEDERAL BLDG
1520 MARKET ST
ST LOUIS MO 63103

16475
Ser 3
3 December 1976

U. S. Environmental Protection Agency
Attn: Mr. Jerome H. Svore
1735 Baltimore
Kansas City, MO 64108

Gentlemen:

We have reviewed the draft environmental impact statement for George Neal Steam Electric Generating Station, Neal Unit 4. We have no comment to offer on this document.

Thank you for the opportunity to review this environmental impact statement.

Sincerely,

C. E. Johnson, Jr.
C. E. JOHNSON, JR.
Environmental Protection Administrator
By direction of the District Commander

Copy to:
COMDT (G-WEP-2/73)
DOT SECREP Region VII
DOT (tes), Office of Environmental Affairs
CEQ (5)

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
823 Federal Building, Des Moines, Iowa 50309

November 5, 1976

Jerome H. Svore
Region VII Administrator
Environmental Protection Agency
1736 Baltimore
Kansas City, Missouri 64108

Dear Mr. Svore:

We have reviewed the Draft Environmental Impact Statement for the George Neal Steam Electric Generating Station, Neal Unit 4, in Woodbury County, Iowa.

We have no comments at this time.

The opportunity to review and comment on this proposed project is greatly appreciated.

The Soil Conservation Service would be happy to furnish assistance with general site preparation through the local Soil Conservation District.

Sincerely,

William J Brune

William J. Brune
State Conservationist

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

CENTRAL REGION
601 EAST 12TH STREET
KANSAS CITY, MISSOURI 64106

DATE: November 16, 1976

IN REPLY REFER TO: ACE-4

SUBJECT: Draft - EIS - George Neal Steam Elect. Generating Station, Unit

FROM: Chief, Planning and Appraisal Staff

TO: Jerome H. Svore, Regional Administrator

The stack and the generator building for the generating plant were the subjects of Aeronautical Study No. 75-CE-579-OE and 75-CE-580-OE, respectively, and received a "No Objection" airspace determination January 19, 1976. This airspace determination expires July 19, 1977.

The stack was airspaced for a height of 470' (AGL) and a maximum of 1546' (AMSL). On the basis of our study, neither structure will exceed obstruction standards of Federal Aviation Regulation, Part 77, and neither will be a hazard to air navigation provided appropriate obstruction marking and lighting of the structures is accomplished.

We have no objection to the generating plant or stack.

James H. King
JAMES H. KING

FEDERAL POWER COMMISSION
REGIONAL OFFICE
31st Floor, Federal Building
230 South Dearborn Street
Chicago, Illinois 60604

December 21, 1976

Mr. Jerome H. Svore
Regional Administrator
U. S. Environmental Protection Agency
Region VII
1735 Baltimore
Kansas City, Missouri 64108

Dear Mr. Svore:

As requested in your October 12, 1976 letter, we have reviewed the need for power presentation given in Chapter 1 of the Draft EIS being prepared for the addition of the coal-fired, 576 megawatt, Unit No. 4 to the George Neal Steam-Electric Generating Station operated by the Iowa Public Service Company. Unit No. 4, scheduled for service in May 1979, is to be jointly owned with major interests by Iowa Public Service Company (43 percent), Interstate Power Company (17 percent), Northwest Iowa Power Cooperative (17.4 percent), Northwestern Public Service Company (8.7 percent) and Corn Belt Power Cooperative (4.9 percent). Remaining interests in the Neal No. 4 Unit range from one to 15 megawatts and are divided among eight municipally owned electric systems.

Comments of this office are in compliance with the National Environmental Policy Act of 1969, and the August 1, 1973, Guidelines of the Council on Environmental Quality.

The projected capabilities and capacity obligations of the Iowa Public Service Company as shown in Exhibit I-C-4 are consistent with data reported by them in the Mid-Continent Area Reliability Coordination Agreement (MARCA) Report to the Federal Power Commission pursuant to Commission Order 383-3. Likewise, the capability projections of Exhibits I-C-2 and I-C-3 are the same as the data reported by MARCA in their 1976 Appendix A-1 report.

Iowa Public Service Company, in their Form 12E-2 report to the Federal Power Commission, projects an approximately 7.4 percent average annual growth in system peak load over the period 1976-1985. Similar peak data for the combined Iowa Public Service Company and Corn Belt Power Cooperative systems presented in the MARCA Appendix A-1 report shows a projected growth rate of 7.6 percent for the 1976-1985 period. Based on our analysis of these projections and a comparison of them with data submitted by other systems in the area, we believe the estimates are reasonable.

Analysis for the combined Iowa Public Service Company and Corn Belt Power Cooperative load and supply presented in the 1976 MARCA Appendix A-1 report indicates that without the addition of the Neal No. 4 Unit as planned, reserves for these systems will fall to 11.9 percent by the summer of 1979 and to 4.9 percent by 1980. This also assumes that approximately 135 megawatts of new combustion turbine peaking capability currently under construction and a 25 megawatt share of the new Council Bluffs steam unit will be available prior to the 1979 summer peak period.

Interstate Power Company reserves for the summer of 1979, as determined from the 1976 MARCA Appendix A-1 report, would be 15.9 percent of their annual adjusted net demand if Neal No. 4 is not available and they would fall to 10.0 percent by the summer of 1980 without the addition of the Neal unit. Even with the addition of the No. 4 Neal Unit, Interstate's reserves are projected to fall nearly 150 megawatts below their reserve obligation level before the addition of their next scheduled unit in 1985.

Northwestern Public Service Company's 1979 net generating capability is projected to fall 16 megawatts below their projected system demand if the Neal No. 4 Unit is not available as scheduled. Even with the addition of the new Neal Unit, Northwestern's reserves will be two megawatts below their 1979 pool reserve obligation.

Northwest Iowa Power Cooperative (NIPCO), the remaining system with a significant interest in the Neal No. 4 Unit, at present receives all its power from the Basin Electric Power Cooperative and the U. S. Bureau of Reclamation (USBR). With increasing capacity obligations to their member cooperative systems and a leveling of hydropower available from USBR, it is prudent for NIPCO to secure additional generation resources.

Finally, any surplus capacity upon initial installation of Neal No. 4 Unit would be available to other systems in the MARCA region on a short-term basis.

Minimum system reserves required to maintain a reliable electric service are generally considered to be in the range of 15 to 25 percent. In order to assure the continued reliability of the systems sharing in the output of the proposed unit, we conclude that additional capacity equivalent to Neal Unit No. 4 is necessary by the summer of 1979 to satisfy applicants' desired reserve margin criteria.

Very truly yours,

Orel E. Haukedahl
Acting Regional Engineer

OFFICE
OF
PLANNING
AND
PROGRAMMING

BOX 94601 · STATE CAPITOL · LINCOLN, NEBRASKA · 68509 · (402) 471-2414

Governor J. James Exon
State Planning Officer

W. Don Nelson
Director

November 15, 1976

Mr. Jerome Svore, Regional Administrator
Environmental Protection Agency
1735 Baltimore
Kansas City, Missouri

Dear Mr. Svore:

Under the provisions of OMB Circular A-95, this office has completed a state level review of the draft environmental impact statement for the George Neal Steam Electric Generating Station, Unit 4.

The proposed project does not appear to be in conflict with any state level comprehensive plans. No comments were received during the review of the statement.

This letter completes the state clearinghouse review.

Sincerely,

Warren G. White
Natural Resources Coordinator

WGW/klf

STATE OF IOWA

Office for Planning and Programming

523 East 12th Street, Des Moines, Iowa 50319 Telephone 515/281-3711

ROBERT D. RAY
Governor

ROBERT F. TYSON
Director

STATE CLEARINGHOUSE

PROJECT NOTIFICATION AND REVIEW SIGNOFF

Date Received: October 19, 1976 State Application Identifier: 770448

Review Completed: November 9, 1976

APPLICANT PROJECT TITLE:
Draft Environmental Impact Statement, George Neal Steam Electric Generating Station

APPLICANT AGENCY: U.S. Environmental Protection Agency
Address Region VII, 1735 Baltimore
Kansas City, Missouri 64108

FEDERAL PROGRAM TITLE, AGENCY AND CATALOG NUMBER: U.S. Environmental Protection Agency

AMOUNT OF FUNDS REQUESTED:
NA

PROJECT DESCRIPTION:
This is the Draft Environmental Impact Statement for the George Neal Steam Electric Generative Station, Unit 4.

The State Clearinghouse makes the following disposition concerning this application:

☒ No Comment Necessary. The application must be submitted as received by the Clearinghouse with this form attached as evidence that the required review has been performed.

☐ Comments are Attached. The application must be submitted with this form plus the attached comments as evidence that the required review has been performed.

STATE CLEARINGHOUSE COMMENTS:

CH-14 Rev. 9-75

Federal Funds Coordinator

STATE HISTORICAL DEPARTMENT OF IOWA
DIVISION OF HISTORIC PRESERVATION

ADRIAN D. ANDERSON, DIRECTOR
HISTORIC PRESERVATION OFFICER

December 3, 1976

Mr. Jerome H. Svore
Regional Administrator
Environmental Protection Agency, Region VII
1735 Baltimore
Kansas City, Missouri 64108

Re: DRAFT Environmental Impact Statement for George Neal Steam Electric Generating Station, Neal Unit #4.

Dear Mr. Svore:

The opportunity to review and comment on the above draft EIS is appreciated.

If we have properly interpreted the EIS, construction for the above project has been underway since March 1975 (page I-2). This construction apparently was started without the benefit of a cultural resources survey being conducted to determine if potentially significant archaeological, historical and architectural properties might be impacted as a result of alterations to the 450 acre site.

We wish to point out what we consider to be inadequacies of sections of the report pertaining to cultural resources.

A) Section III G; pages 100-102.

1. Reference to published and unpublished literature utilized in preparation of the section is not indicated. This makes it difficult to evaluate the accuracy of the section.

2. Also lacking is any indication that a cultural resources survey was made of the project site.

3. Apparently there is a misunderstanding of the applicability of information provided from the Division's inventory. The The Division has not and does not consider the available inventory data to be sufficiently complete to adequately represent the potentially significant cultural resources in this area. Nor has the Division ever advised any agency that such data obviates the need for thorough, well-planned and well-executed, cultural resources surveys, nor is this data intended to be a surrogate of such surveys.

3-13 MAC LEAN HALL . IOWA CITY, IOWA 52242
TELEPHONE 319.353.6949/319.353.4186

4. The information contained in Section III G-2 does, however, represent what was available, to our knowledge, at the time It is, however, inadequate.

5. Reference to a "historical, archaeological, and cultural survey" (III page 102) does not pertain directly to the impact of the above project since it concerns the proposed Snyder-Winnebago Bends Recreation Areas.

B) Section IV 1 (page 76).

6. The statement, "No historic, archeologic site...will be adversely impacted by the transmission facilities", is made. This should be modified to read, "No (known) historic sites, archeologic sites...will be adversely impacted by the transmission facilities."

Additional comments, relating to the assessment of potential impacts on cultural resources, are as follows:

7. No surveys known to us have been made of the proposed or alternate transmission line routes. There are no known sites which would be impacted along these routes but this does not obviate the need for surveys and such should be done prior to approval.

8. Finally, consideration should be given to two steamboat wrecks recorded to have occurred somewhere within two miles of the transmission facility. Six additional wrecks are reported to have occurred between Sioux City and Winnebago Agency.

We hope the above comments will be of use in preparing the final EIS of the above project and look forward to reviewing a much improved section of the final statement.

Sincerely,

Adrian D. Anderson

Adrian D. Anderson, Director
State Historic Preservation Officer

ADA/af
cc: William Butler, IAS, Denver
Chuck Spilker, National Advisory Council
on Historic Preservation

The University of Iowa
Iowa City, Iowa 52242

1847

Office of the State Archaeologist
Eastlawn
(319) 353-5175, 353-5177

January 3, 1977

Mr. Daniel A. Vallero
United States Environmental Protection Agency
Region VII
Kansas City, Missouri 64108

RE: George Neal Steam Electric Generating Station, Neal Unit 4

Dear Sir:

Thank you for the opportunity to comment on this report. Reference is made in the report to the identification of historic and archaeological sites in the vicinity of the project (Chapter III, Section G, 101-102). However, the sources for this work are not cited in the bibliography.

Further it appears from the discussion of cultural resources that only a literature search was done of the project area and not a cultural resource reconnaissance survey. A literature search alone is not sufficient for evaluating the potential impact on cultural resources that may be present in the project area. Could you please clarify these matters?

We would also like written assurance that if no cultural resource field survey has been done, that such a survey will be conducted with ample lead time prior to the construction of the generating station.

Sincerely,

Duane C. Anderson

Duane C. Anderson
State Archaeologist

DCA:bh

Iowa State University *of Science and Technology* *Ames, Iowa 50011*

Department of Earth Sciences
253 Science Hall I
Telephone 515-294-4477

October 26, 1976

Mr. Jerome H. Svore
Regional Administrator
U. S. Environmental Protection Agency
Region VII
1735 Baltimore
Kansas City, Mo. 64108

Dear Mr. Svore:

In looking over the draft environmental impact statement for the George Neal Steam Electric Generating Station, Neal Unit #4, I have the following comments:

1. I did not see any reference to the coal pile runoff area being sealed on the bottom. Therefore, any material that filters through the coal pile will certainly move into the ground water. The leachate developed as it moves through the coal pile has a possibility of containing some of the trace elements listed in the table in the report. Likewise, I did not see any reference to the dissolved solids composition of the coal pile runoff. I do not know exactly what this is, but I have read reports where this concentration can be extremely high.

2. The leaching potential of the ash ponds was discussed as a possibility and that an analysis would be conducted to determine this. I did not see any alternatives listed should the results show that leaching does occur and that the ground water does become contaminated by the leachate produced from the ash ponds. It is important that a proper ground water study be conducted to determine the potential for contamination from these ponds and also from the coal pile.

I feel that the potential contamination of the ground water by both the coal piles and leachate developed from ash ponds is an area that needs to be investigated properly. I do not know of recent literature that addresses itself to this problem and would be very

Mr. Jerome H. Svore
October 26, 1976
Page 2

interested in seeing the data developed by consultants for the owners of this new generating plant.

Sincerely,

Lyle V. A. Sendlein
Professor of Geology

LVAS:bd

Iowa Confederation of Environmental Organizations

P.O. Box 1147 • Ames, Iowa 50010

ICEO

December 16, 1976

Mr. Jerry Svore, Regional Administrator
Environmental Protection Agency
Environmental Impact Statement Program
1735 Baltimore
Kansas City, MO 64108

Dear Mr. Svore:

Please accept these comments respectfully submitted in response to the Draft EIS on the George Neal Electric Station #4.

We conclude that the major issue is the need for George Neal #4 which has not been demonstrated by the acceptable techniques of demand forecasting. Also, equally serious omissions are alternatives to construction, most particularly load balancing efforts, peak pricing mechanisms and public information and conservation program to reduce demand in the residential and industrial sector.

A principal concern with respect to the George Neal complex is the air pollution impacts of the existing three units and the fourth unit as projected. Our specific comments point out the inadequate considerations given to the economically most important pollutants and emphasize the failure of the draft EIS to review the scientific data available as well as the episodes of crop damage due to coal-fired plumes that have already been documented.

Other shortcomings in the EIS are evident, but time and resources prevent our full review at this time.

Sincerely yours,

James J. O'Toole

James J. O'Toole
Acting Chairman

Enclosures

ALTERNATIVES TO PLANT CONSTRUCTION

Under Sec. 102(c)(iii) of NEPA, the alternatives to the proposed project have not been adequately explored. This fact is emphasized in the description entitled, "Need for Power" starting on page I-9. Documentation for need does not appear in MARCA projections. Such documentation, to be valid, requires the support of econometric projection based on price/demand techniques of analysis which are well established. In general, electric utility marketing programs until recently have ignored these scientific techniques for projecting power demand, with the result that the mushrooming cost of power production has generated spiralling rate increases. These rapid sequences of rate hikes have resulted in decreasing electricity usage, consequent idle generating capacity and dramatic loss of investor confidence in the utility industry. Overcapacity and decreased earning in 1974 and 1975 led to a crisis. According to Bankers Trust Company of New York, "Probably no industry has come closer to the edge of financial disaster."

This dilemma within the industry has been the result of casual and inadequate demand projections based on historical extrapolations in a market that has changed dramatically. Since 1970 when the cost of electricity production stopped its downward trend, considerable increases in production costs due to rapid rises in the cost of installed kilowatt capacity combined with decreasing availability factors of newer large units, have harnessed utility customers with a legacy of debt for idle generating capacity. The present situation calls for a new pricing philosophy based on equitable and sound economic techniques of analysis. Applications of these techniques are nowhere in evidence in this Draft EIS of the Neal generating station. Basically, two major considerations need to be addressed.

1. Failure of historical pricing mechanisms to relay to the consumer through price signals the costs of his service on the basis of time and quantity of demand.

2. The failure to apply appropriate and established econometric techniques of price/demand analysis to project future demand, so critical to estimation of capacity needs.

Correction of the flaws in pricing mechanisms are being undertaken by many utilities, principally through orders from their state utility commissions (Wisconsin, Missouri, Vermont, New York, Michigan, Florida, etc.). These corrective actions are reflected in efforts to initiate marginal cost pricing and time of day pricing which in combination can convey accurate price signals and improve load balancing over short, intermediate and long run periods. To list these specific cases and techniques requires considerable space, but the options are well described in recent orders of the Wisconsin Public Service Commission and in the recorded testimony of Iowa Commerce Commission hearings of December 7, 1976. Excellent detailed testimoney by recognized rate economists are readily available (Charles J. Cicchetti in Pacific Gas & Electric Company application #54279 before the California Public Utilities Commission and in Madison Gas & Electric Company Docket #2-U-7423 of the Wisconsin Public Service Commission; also Fred J. Wells in Docket #U-1933 before the Arizona Commission on behalf of Tucson Public Power.) A brief report by J. Robert Malko, Chief Economist of the Wisconsin Public Service Commission (Public Utilities Fortnightly, July 15, 1976) is attached which describes the philosophy and feasibility of marginal cost pricing and time of use pricing now being initiated in Wisconsin.

Efficient load management cannot be achieved without accurate cost of service information and the fair allocation of those costs to the users creating the demand. The present declining block rate structure in general practice does just the opposite, it rewards the consumers creating peak demand through subsidies paid by off-peak users. Such rate structures did not appear inequitable when the cost and price of electricity were declining due to economies of scale and other efficiencies. Since 1970, however, the increasing costs of power have only emphasized the social inequities and economic fallacy of declining block rates.

Perhaps the most serious omission in the Neal EIS is the absence of justification supported by valid data which would lend credence to growth projections claimed. In particular, the three utilities (Iowa Public Service Company, Interstate Power Company and Northwest Iowa Power Cooperative) claiming the lion's share of the George Neal IV output disclose no information on cost of service or load analysis to support the need for the new station. Specific data are also lacking on the capital cost of George Neal IV, its anticipated capability factor and its impact on retail prices of electricity in the residential and industrial service sectors.

Such data voids cannot be explained away by claiming lack of information. In particular, the methods of forecasting demand based on the accepted procedures using economic models is by now a well-recognized technique in the industry. A study published in 1975 by the Federal Power Commission demonstrated that the projections of power consumption by the National Electric Reliability Councils for 1980 were about 40% too high when econometric demand analysis techniques were applied to each NERC. In particular, MARCA projections were 49% too high. A copy of the report, "Electricity Demand: Project Independence and the Clean Air Act", ORNL-NSF-EP-89 is attached. Overforecasting demand is a serious economic flaw, especially since debt retirement of today's new facilities accounts for roughly 75-80% of the average bill.

Exhibit A is a list of references describing applications and results of demand forecasting. We urge that these techniques be considered in developing an economically and socially acceptable procedure that can more accurately assess the need for George Neal IV.

The Neal Draft EIS does not adequately report upon nor discuss the data used as the basis for projecting demand in the MARCA and MAPP region as indicated in the EIS.

We anticipate that, to a large extent, the data necessary to accurate demand forecasting is in the files of the utilities but additional data may be required to apply the appropriate forecasting technique referred to in our Exhibit A. The data needed for this type of analysis is well expressed in the statement (Exhibit B) by Mr. Robert O. Marritz, executive director of the Missouri Basin Systems Group and in Exhibit C by Mr. Roy B. Hurlbut, utility specialist and energy adviser. These two exhibits are taken from testimony presented to the Iowa Commerce Commission at its hearing on December 7, 1976. We urge that the data needs described in these two statements be obtained and a re-evaluation of need for George Neal IV be made on the basis of professional econometric analysis. NEPA is very clear in emphasizing that all agencies "Utilize a systematic, interdisciplinary approach... in decision making."(102A) CEQ Guidelines (38 Fed Reg 20550-20562, 1973) express the responsibilities of Federal agencies to develop a "rigorous exploration and objective evaluation of the environmental impacts of all reasonable alternative actions, particularly those that might enhance environmental quality or avoid some or all of the adverse environmental effects, is essential." 1500.8(4). It is apparent that in the failure to treat the issues of demand forecasting and the application of marginal cost pricing and time of use pricing, viable alternatives, which might result in postponing or cancelling this economically and environmentally costly generating capacity, were precluded from consideration. We urge this omission be rectified in a supplemental draft EIS.

ENERGY CONSERVATION OPTIONS

The role of energy conservation has been ignored in the Neal EIS. Options to save energy in electric power consumption are many and varied. The environmental and health costs of fossil fuel combustion are well documented in EPA and CEQ publications. The political implications of energy saving have been emphasized in Project Independence reports and Federal Energy Administration literature. The economic burden in higher utility bills to consumers caused by the new George Neal IV station are not analyzed in relation to the potential savings to be gained from conservation techniques. It is obvious that any program of conservation requires some investment. What is needed in this case is a Cost/Benefit analysis of alternatives which in fact are called for under CEQ guidelines.

Conservation measures should be considered in two general ways: (1) greater efficiencies at the same level of consumption, and (2) modifications of technology and/or practice which decrease total energy consumption.

The first approach can be achieved through load balancing and full substitution. Load balancing had been effectively demonstrated in peak load pricing techniques in Vermont and is now underway in Wisconsin and planned by several other states. Pennsylvania Electric Company simply through a publicity campaign aimed at reducing residential peaks, realized a

22% improvement with a $700,000 saving. Fuel substitution using the more efficient fossil fuels for hot water and space heating as opposed to electric is capable of reducing peaks as well as total use.

Information on appliance efficiency is a valuable help in consumer selection of high wattage units. Air conditioners are a prime target since they create the summer peaks in midwest residential demand. A study of a Missouri service area showed that replacing all air conditioners of low efficiency with the most efficient models available would be a cheaper option than building the power plant required to meet the rising demand created by the old air conditioner peak.

Such options for conservation should be analyzed on a cost/benefit basis of KW of demand saved vs newly installed generation capacity. The response of industrial customers in Iowa to load management programs is proved by the successful test run by IPALCO to reduce load of 15 large consumers in the summer of 1975. The projected periods of high demand were relayed to the cusomters who were given credit for reducing their demand. Peak power was reduced by 3521 KW at a cost of $10,563 in credits. Contrast this to an installed cost of $800/kw which would require a capital investment of 2.8 million dollars. In summary, we urge that conservation alternatives be initiated and developed under guidelines of the Energy Conservation Act of 1976 and the assistance of other Federal, state and private parties as directed under NEPA and CEQ Guidelines. The alternative of "Not Providing Power", p. VI of the EIS, is a wholly inadequate statement in addressing the alternatives contained in para. 102(c)2(iii) of NEPA.

AIR EMISSIONS

In estimating air emissions, first order consideration is coal composition. In the EIS, p. II-3, the presently operating Neal Units 1-3 are described as using Hanna Wyoming coal with an average sulfur content of 0.6%. This coal created an emission rate of 1.3 lb/mB which is permissible for old sources but would not be for new sources. Over on p. IV 56 an inconsistency appears when the typical S content is said to be 0 32%. This, we presume, is the same Wyoming coal source. Such casual use of analytical data is unacceptable for several reasons.

1. Sufficient replicates of coal should be analyzed to provide a variance and confidence level of analysis.

2. Coal should be sampled in the prescribed manner throughout the seam and throughout the seam face in order to provide a measure of the variance of the chemical constituents due to the naturally occurring compositional differences. Adequate chemical data have been reported on Western coals to demonstrate large naturally occurring chemical variances within a seam on both vertical and horizontal axes. In the case of sulfur, this variance can be threefold. It is therefore possible for George Neal IV to exceed Federal emission standards for extended periods when higher sulfur areas are encountered. Unless more definitive evidence is presented to assure compliance, we urge scrubbers be installed.

The emission of minor constituents released either as a gas or particle has not been treated adequately. The toxicity of many of these elements is well known, e.g., the heavy metals Pb, Cd, As, Se, Hg, etc., and the lighter elements Be and F. The mass balance of these elements through the plant should be considered in detail. There is a sequestration process taking place in all coal-fired plants. Some elements are found enriched in bottom ash while some are enriched in stack gases and fly ash. The trend for many toxic elements to become enriched in the small particulate size (.1 to 1 micron) of fly ash poses respiratory threats since they reach the lung alveoli. Even though these particulate releases may meet emission standards, they add to air shed loads since they are capable of being transported large distances. These incremental pollutant loads added to urban air sheds should be discussed in relationship to the findings of EPA's CHESS report. Such factors also should be considered on a Cost/Benefit basis.

Of these minor elements, fluorine poses a very great threat to vegetation. It is 100 to 1000 times as toxic as sulfur dioxide and the sulfur/fluorine ratio in Western coal makes fluorine a greater threat to sensitive native and agricultural plant species than sulfur. The phytotoxic effects of fluorine were discussed by Gordon et al. at the American Chemical Society Symposium on Fluorine Compounds in the Environment, 8/31/76 at San Francisco, California. We urge that direct data on fluorine concentrations in the air and environment of George Neal units 1-3 be determined. The environmental sampling program reported by Gordon in Montana showed fluorine accumulation and significant pathology to native vegetation in the vicinity of a 180 MW power plant burning Rosebud seam coal, a "typical" Western low sulfur coal. The impact of 1573 MW of George Neal 1-4, by comparison, approaches an order of magnitude greater threat.

EIS p. IV-63, Effects on Terrestrial Biota

This section, which deals with potential impacts of very significant economic importance, is deficient in addressing the known scientific facts about sulfur dioxide pollution. It also attempts in the opening paragraph to place this serious plant toxin in a favorable light by suggesting a minor and debatable benefit. Indeed, the fact that leaf stomata take up SO_2 is the principal explanation for the first step in the toxicity chain of events.

The conclusion on p. IV 63, "it appears unlikely that the predictable maximum annual concentrations from George Neal Units 1-4 will injure flora of the site and surrounding region" is made in the face of scientific evidence to the contrary. Much is made of the data projected from diffusion modelling which would support the hypothesis that emissions from all four units will meet ambient and emission regulations. In the first place, we believe that these projections are inadequate substitution for sufficient field observations which should have been underway at sites 1-3 and carried out in a more purposeful scientific design. Even dismissing this criticism, however, the facts under consideration in the NEPA process are not simply compliance with regulations, but the estimation of any impact this project will produce irrespective of regulations. The following observations amplify the impacts of sulfur dioxide and emphasize the omissions of these important data in the draft EIS.

1. The sensitivity of economically important crops in this area, corn and beans, has been demonstrated in controlled experiments at SO_2 levels well below even secondary standards. In 1966-7, the National Air Pollution Control Administration carried out greenhouse studies in Kansas City on sensitive plant species including corn and beans. The experimental plots were grown in an atmosphere whose SO_2 levels during the growing season were below Federal ambient standards. Nevertheless, plant growth was suppressed 25-50% compared with controls.

2. Serious fumigation episodes at Mount Storm, West Virginia in 1972 and Kyger Creek, West Virginia in 1973 caused extreme foliar damage. In July of 1971 and twice during 1974, the plume of the TVA 1750 MW Shawnee plant fumigated at acute levels affecting 26,400 acres of soybeans in 1971 and 41,800 of vegetation in 1974. EPA representatives made field observations during these episodes and a full description including the potential for similar impacts at the George Neal site should be presented. In addition, the comments of Dr. Clarence C. Gordon, Plant Pathologist, University of Montana, Missoula, who investigated and reported on these episodes, should be sought.

3. The National Environmental Research Laboratory of EPA has been conducting Zonal Air Pollution research with SO_2 at their Montana study site. Results of these studies should be obtained and the data, where possible, used in evaluating vegetative impacts at the George Neal site.

4. The section on acid rain (EIS, p. IV-67) is a vague and incomplete description of the scientific knowledge and true impacts of acid rain. Since 1952, European investigators have carried out precipitation chemistry studies throughout western Europe. These studies, which are reported in over 100 scientific articles, demonstrate rather vividly that acid rain primarily caused by atmospheric emissions of the industries of Germany, France, and England have caused in the past and are currently causing a serious impact upon the aquatic and terrestrial ecosystems of Norway and Sweden. A condensed version of what is currently knownabout acid precipitation and its effect on ecosystems can be found in a 1976 USDA 1,074-page publication (Technical Report NE-23), "Proceedings of the First International Symposium on Acid Precipitation and the Forest Ecosystem." It is imperative

that the EIS writers obtain this publication and attempt to relate the known data to the potential SO_2 and NO_2 emissions to be released from stacks of George Neal units 1-4. In amplifying further the specific impacts on plants of acid rain, we suggest the report of Gordon in "Proceedings of Fort Union Coal Field Symposium 4/25-26/75" at Eastern Montana College, Billings, be reviewed. Also important is Gordon's testimony before the Montana Energy Siting Board in 1974-75. The need for a rainwater monitoring program to determine the acid rain potential of the currently operating George Neal Units 1-3 is essential. It should have been initiated at least by the Spring of 1976 when NEPA procedures began to be applied. The entire on-site monitoring program for providing needed data on the phytotoxic pollutants is inadequate. We urge that steps be taken to design a program that will provide sufficient data to establish a benefit/cost analysis on potential economic impacts to agricultural crops resulting from the George Neal complex.

The effects of air pollutants on higher animals starting on p. IV 69 of the draft EIS omits impacts on man. Perhaps the reasoning here is that the primary ambient air regulations of the Clean Air Act cover adequately such impacts. In our interpretation of NEPA, such is not the case. CEQ guidelines emphasize the importance of detailed considerations of all impacts. In the case of the George Neal plume, the annual loads of pollutants released are huge and may increase. The ultimate fate of these pollutants, SO_2, F, NO_x particulates with toxic trace elements, have to be evaluated carefully and their potential effects discussed. These pollutants in part are deposited locally, yet the bulk of all are transported considerable distances off site. They may be ultimately precipitated by wet and dry deposition processes, arriving at target sites which may be highly sensitive or refractory. At any rate, they contribute to pollutant loads in adjoining air sheds and such incremental threats to human health, biota, and materials are not insignificant by any means. These effects should be evaluated. The atmospheric modelling and Benefit/Cost analysis technique of EPA are capable of providing such information. Such concepts are already incorporated into the non point source philosophy. Through these and the previously cited considerations, the provision of NEPA can receive the substantive response it demands and the ultimate best alternative rationally adopted.

James J. O'Toole

James J. O'Toole
Acting Chairman
Iowa Confederation of
Environmental Organizations

EXHIBIT A

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EXHIBIT B

Testimony of Robert O. Marritz
In the Matter of Regulations Proposed
By the Iowa State Commerce Commission
For "Location and Construction of
Electric Power Generating Facilities"

DOCKET NO.
RMU-76-3

My name is Robert O. Marritz. I reside at 706 Lake Washington Boulevard South, Seattle, Washington 98144.

For the past ten years I was employed as Executive Director and Staff Counsel of the Missouri Basin Systems Group (MBSG), with offices in Lakewood, Colorado. MBSG is a regional electric power supply planning and pooling group composed of 120 consumer-owned electric systems and the U.S. Bureau of Reclamation. MBSG member systems serve portions of Montana, Wyoming, Colorado, The Dakotas, Nebraska, Kansas, Minnesota and Iowa.

In my capacity with MBSG I was responsible for supervising planning studies to determine future power supply requirements of MBSG members. I have also represented MBSG members in engineering and economic studies involving other utilities and groups, including at least one of inter-regional scope.

My most recent activity with MBSG, relating to planning of generating facilities, involved the Missouri Basin Power Project (MBPP). The project is comprised of the 1500 megawatt Laramie

River Station and an extensive 230 and 345 kilovolt transmission system. It is located in southeast Wyoming and will come on line between 1980 and 1984. Between 1973 and 1976 I was very actively involved in project planning as Chairman of the Project Management Committee, Project Coordinator and as ex officio member of the Engineering and Operating Committee. I also participated in Siting Studies and other analyses leading to sizing and location of the required facilities.

I am a graduate electrical engineer (BSEE, 1961) from the University of Pennsylvania, and hold a law degree (LL.B., 1965) from the George Washington University. I am a member of the bars of the State of Colorado and the District of Columbia.

This testimony is being submitted at the request of the Iowa Energy Foundation.

Information Required to Plan
Power Supply Facilities

In order to determine the specific increments of electric generating facilities required to meet anticipated requirements, it is necessary to assemble and analyze various historic and projected data. In my experience, these data should include, among others:

(1) system peak demand, by season or month, for approximately the past ten years;

(2) total system energy consumption, by season or month, for the past ten years;

(3) forecasted total system peak demand, by season or month, for the ensuing ten to fifteen years;

(4) forecasted total system energy consumption, by season or month, for the ensuing ten to fifteen years;

(5) for data in (1) through (4) above, actual and forecasted requirements data for residential, commercial and industrial consumers;

(6) for each of the past ten years, nameplate kilowatts and actual kilowatt hours generated for each generating unit, with class (baseload, intermediate or peaking) and type of generation (e.g., coal, nuclear, gas, oil, or hydro) indicated;

(7) for each of the ensuing ten to fifteen years, nameplate kilowatts and projected kilowatt-hours to be generated for each existing and planned unit, with class and type of generation indicated;

(8) for each of the past ten years, a load-duration curve for the system's demand;

(9) for each of the ensuing ten to fifteen years, a load-duration curve for the system's projected demand; and

(10) an analysis of hourly, daily, monthly and seasonal system load trends, including information on the bases and methodology for projections made in (3), (4), and (5) above.

The above data, particularly that encompassed by (1) through (4) and (7) would be necessary, in my view, to a utility planning additional generation. Specifically, projected capacity (kw) and energy (kwh) data are both required, as well as historical data, to analyze the type of generation increment which should be considered by a utility. (Projected capacity and energy data was, I might add, furnished the Wyoming Public Service Commission by the applicants in the Missouri Basin Power Project.)

As one example of why both capacity and energy data are required, a projected deficiency of 500 megawatts does not necessarily imply a requirement for a 500 megawatt net block of baseload generating capacity. Depending upon the indicated associated energy requirement, the utility's need might be met by 500 mw of peaking capacity, or some mix of baseload, intermediate and peaking.

EXHIBIT C

QUALIFICATIONS OF ROY B. HURLBUT

Roy B. Hurlbut, Salem, Oregon, is a utility specialist and energy adviser, with over twenty years of experience, most of which was in the private utility area. He is co-author with Battelle Labs of the Oregon Energy Study, a comprehensive study of the energy demand, energy resources, and the social and environmental impact of energy resource utilization; Demand, Supply, and Price--a Plan for Optimum Energy Planning (1974), and has testified as an expert witness in numerous rate cases before regulatory bodies. Mr. Hurlbut received his BSEE degree in 1962 from Heald College, and his MBA in 1968 from the University of San Francisco. In 1973 he completed the NARUC course on Utility Economics and Regulation at Michigan State University. Mr. Hurlbut is a member of the Institute of Electrical and Electronic Engineers (IEEE) and the National Association of Business Econ- [illegible]

STATEMENT OF ROY B. HURLBUT

My name is Roy B. Hurlbut, my address is 804 Faymar Drive NE, Salem, Oregon 97303. I have been asked by the Iowa Energy Foundation to review the proposed Iowa State Commerce Commission's draft rules (Commerce Commission 250 - Chapter 24) for the purpose of any additions or changes to these rules which will be the basis for utility filing requirements in the State of Iowa.

A. THE NEED FOR IMPROVED ENERGY PROJECTION

Faulty forecasting and improper utility plant utilization are causing the energy consumer to pay higher utility bills. Study the forecasts. First, energy usage has been running below expectation on a national level. As electricity usage falls, revenues decline faster than costs, so utilities wind up with less profit, or, in some cases, a loss. Then, the utility must go before the state regulatory commission to request rate relief. Second, utilities have historically added new plant to meet peak. This results in much idle capacity and increased expenses, which means higher rates for consumers, as well as capital funding problems for utilities.

The first of these dilemmas, i.e., faulty forecasting, can be resolved to a great extent by having utility filing requirements which give proper definition to each of these categories.

This information, for the most part, can be found in the Form 1 and Form 12 utilities submit to the Federal Power Commission.

The alleviation of the plant utilization problem can be resolved, to a great extent, with load management. Regulatory agencies, such as the Central Vermont Public Service Corporation and the Wisconsin Public Service Commission, have both directed that utilities devise rates for electricity at a rate closely related to the cost of producing and supplying it.

B. DEMAND VS. RATES

One fact that utilities (for the most part) have failed to address is the elasticity of demand, and as the consumer pays more and more for his energy, he will, out of economic necessity, consume less. In the meantime, utilities are sticking to their forecasts, stating the present dip is only a temporary perturbation. Large capital budgets, the sine qua non for rate increases, are being expanded to meet what utilities assume will be a doubling in demand in the next 10 years. The obvious inequities in pricing policies by some state regulators, which place industrial rates below average bus bar cost of production, result in the residential users subsidizing the industrial customers.

The need to select the best energy alternatives with the least environmental affects should be pursued.

All of these problems can be lessened to a great extent by better planning and more detailed filings.

The basic information to be compiled should be:

1. The nature and extent of the energy supply situation.

2. The projected availability and cost for different types of energy.

3. Technical alternatives available now, or predicted at some future date, and economic and environmental impacts on the various alternatives.

4. The effect of existing and projected safety and environmental standards.

This inquiry should be divided into three phases:

Phase 1 should be summary presentation of anticipated future energy requirements of Iowa electric and gas consumers, together with utility plans for meeting these requirements, which should be made by both public and private utilities. It is important to note that the impact of elasticity of demand should be shown in Phase 1.

Phase 2 should be present and future alternatives, including types of present and future energy generation productions alternatives, and types and cost of fuels available now and in the future.

Phase 3 should be comments of other concerned agencies, individuals, and groups on the information presented in Phase 1.

In addition to the need for better long-range planning is the need to make industry more efficient. The large manufacturers of electrical machines have not moved fast enough. Energy conservation must be a way of life, an ever present life style. Penalties for over-use should be dispensed with the same dispatch as a traffic policeman handing out a ticket for speeding. Off-peak consumption of power should be encouraged by establishing off-peak rates. This shift would level the peaks, reducing the capacity needs of the over-all system.

The Iowa State Commerce Commission can, and should, take an active part in the planning of the over-all energy needs of the state.

RESPONSES

UNITED STATES DEPARTMENT OF THE INTERIOR

COMMENT 1: We note from Exhibit 1-A-2 that the project is approximately one-third complete. As a result, many decisionmaker options have been foreclosed and the utility of an environmental statement at this point in project development greatly reduced. Especially significant is the elimination of opportunities to implement the alternatives discussed in Chapter V with the exception of those mentioned in Section D. For example, further consideration of alternate plant sites and alternatives to a once-through cooling system are precluded.

RESPONSE: The on-going construction has limited many alternative options. However, in view of the information outlined in Chapter I, the necessity for increased generation capacity requires the plant to be on line by 1979. Therefore, in order to meet power quotas and schedules, construction of Neal Unit 4 has continued.

COMMENT 2: The environmental statement should recognize that the "Browns Lake (Bigelow Park)" briefly described on page III-105 has received matching assistance from the Land and Water Conservation Fund for the development of public recreation facilities. Although it appears that no land will be taken from this park, the applicant should be aware that this area is subject (in its entirety) to the provisions of Section 6(f) of the Land and Water Conservation Fund Act, as amended. This section of the Act requires that changes from the recreational use of the land be approved by the Secretary of the Interior.

RESPONSE: Chapter III of the Final EIS has been modified to include this information.

COMMENT 3: We suggest that the noise impact on recreation on and around Browns Lake during construction be evaluated. In addition, the statement should include a non-technical discussion of the noise impact of plant operation on both the Snyder Bend and Browns Lake recreation areas.

RESPONSE: The evaluation of noise impact at Brown's Lake and the Snyder-Winnebago Recreation Areas during the construction period is provided in Section IV-G. The location of the recreation areas with respect to the plant site and the range of expected noise has been described.

COMMENT 4: The discussion on page IV-92 suggests that the noise level in the Snyder-Winnebago Bends Recreation Area will substantially exceed the maximum noise level found to permit residential outdoor enjoyment. Therefore, the conclusion on page IV-93 that plant operation ". . . should not have a significant adverse noise impact on the surrounding area" seems unwarranted.

RESPONSE: The comment is valid and the conclusion in Chapter IV (p. IV-93) has been changed. It was based on conservatively high noise level estimates resulting from unsilenced induced draft fans. The applicant has made provisions to install noise abatement devices for those fans, if, after the plant's operation has commenced, noise levels are found to be unacceptable. Page IV-93 has been changed to read "In conclusion, plant operation and maintenance activities at Neal Unit 4 may have an adverse noise impact on the surrounding area due to estimated noise levels of unsilenced induced draft fans."

COMMENT 5: The statement should evaluate impacts on the vegetation, wildlife, and water quality in nearby recreation areas resulting from atmospheric emissions. Where scientific knowledge is inadequate to make accurate predictions, estimates should be given based on observations of impacts resulting from emissions from Neal Units 1-3.

RESPONSE: Impact evaluation as a result of atmospheric emissions in the Neal area has been based on predictive methodology utilizing a computerized atmospheric diffusion model. This model employs plant design and operating parameters for Neal Units 1-4 and a full year of surface and ground level data. Calculations of plant emissions were made for a number of points within 10 kilometers of the site which includes Brown's Lake and Snyder-Winnebago Bends Recreation areas. Using these data, the expected impacts on vegetation and wildlife are discussed in Section IV-5.

The effects of atmospheric emissions on water quality in the recreation areas will not be adversely affected. Effects of acid rain on the pH of the lakes in the vicinity of Neal Unit 4 (Snyder Bend and Brown's Lake) should be minimal due to the apparent buffering capacity of the lakes, the alkalinity of the soils, and the fact the Neal boiler stacks are the only predominant source of SO2 in the vicinity of the site.

COMMENT 6: Also, we believe that the final environmental statement should include a discussion and worst condition analysis of the cumulative impact of noise, visual intrusion, and atmospheric emissions of all four Neal Units and the transmission line on the continued recreational utility of the Browns Lake and Snyder-Winnebago recreation areas.

RESPONSE: Information with respect to the impact significance to the Brown's Lake and Snyder-Winnebago Recreation areas of noise, visual intrusion and atmospheric emissions from Neal Units 1-4 is included in Sections IV-F and G.

COMMENT 7: Information presented in the statement contradicts the conclusion on page V-12 that "the proposed activities would be compatible with the present land use practice of the area."

RESPONSE: Neal Unit 4 is consistent with zoning and industrial development in the Port Neal Industrial District, which is specifically zoned for heavy industrial use. Information regarding other industrial establishments and usage in the district is provided in Section III-H-3.

COMMENT 8: Noise, aesthetic, and air quality impacts on nearby parklands appear to be significant and are in need of a more complete evaluation.

RESPONSE: Impacts to be incurred in the vicinity surrounding the site with respect to noise, aesthetics, and air quality are discussed in Chapter IV, Sections G, A and F, and A and C, respectively.

COMMENT 9: It is unclear from the discussion on page III-102 whether the cultural resource survey undertaken in May, 1973, included the proposed George Neal Steam Electric Generating Station, Unit 4, as well as the proposed Snyder-Winnebago Bends Recreation Area. In the event that the 1973 inventory included the Unit 4 project area, the statement should provide detailed information concerning the inventory and analysis of cultural resources within the affected area, including a description of the survey methods utilized and extent of archeological testing. Complete coverage of the entire project area including access roads and transmission facilities by a professional archeologist is necessary.

RESPONSE: Refer to response to the State Historical Department of Iowa. Monitoring by a qualified professional for the occurrence of unknown archeological resources during construction are being arranged by the applicant.

COMMENT 10: Copies of correspondence with the State Historic Preservation Officer (Mr. Adrian Anderson, Division of Histroic Preservation, B-13 MacLean Hall, Iowa City, Iowa 52242) and the State Archeologist (Dr. Duane C. Anderson, 21 MacLean Hall, University of Iowa, Iowa City, Iowa 52242) should be included within the statement. The statement should further reflect procedures to be followed should previously unknown archeological resources be encountered during project development.

RESPONSE: Refer to comment letter and response to comments submitted by State Historical Department of Iowa.

COMMENT 11: We understand that the best possible methods will be used so that impingement on aquatic life will be kept at a minimum. This is commendable but it is quite certain that the entrainment will be of a greater magnitude than that described in the draft environmental statement. Species composition of fishes found at other Missouri River generating stations do not compare favorably with data gathered for the George Neal Station. A fair job has been done in qualifying the fishes that will be lost during the once-through cooling process; a poor job has been done in quantifying these losses. Numbers of fishes are of little use for entrainment studies when these numbers are not correlated with volumes of water sampled. The draft environmental statement should identify the problems of entrainment in a more definitive manner and describe what is to be done to lessen the impacts resulting from this type of cooling process. Two methods of mitigating the losses could be considered. One is to limit the velocities of water withdrawn and a second is to limit the times that the water is withdrawn both seasonally and diurnally. Potential mitigating measures of this nature should be discussed in the final statement.

RESPONSE: The Final EIS discusses a program of study to further evaluate the loss of larval fish and the subsequent impact of this loss on the aquatic community of the Missouri River. If this loss is shown to be significant and detrimental to the aquatic community, the operational changes outlined in Section V-D of the Final EIS and other measures to minimize the impacts will be considered.

It is EPA's position that the loss of larval fish and other planktonic organisms via entrainment is primarily related to the volume of water used for condenser cooling and not by the velocity of water withdrawn. The alternative of reducing velocity to minimize entrainment losses is not considered beneficial and, therefore, is not discussed in the final statement.

COMMENT 12: We are concerned that seepage from the ash disposal area and the coal storage area will contaminate the groundwater. Page V-44 indicates that linings under the coal storage area and the solid waste disposal area are not considered necessary. Likewise the liner for the coal runoff pond will not be installed at this time but will be considered later, if necessary. Little information is provided in the draft statement to support these decisions. More detailed justification for the conclusions should be given in the final statement.

The proper analysis of the impacts of leachates from the ash ponds should be provided. The suggested use of data from existing ash ponds seems appropriate if similar coals have been used in the existing units; we believe, however, that data to be used should include information on effects on the ground water beneath the existing ash ponds in order to provide a firm basis for anticipating or predicting effects. The ground water impact analysis should also include consideration of effects from infiltration of chemicals from the retention ponds A and B discussed on page II-35.

Monitoring programs to determine the impacts on ground water in the ash disposal and coal storage areas should be described in the final statement with specific indication of the mitigating measures the applicant is prepared to implement if contamination of the ground water is significant.

RESPONSE: Possible surface and/or ground water degradation resulting from the coal and ash handling systems is of concern. The NPDES permit will be conditioned to assure compliance with the Safe Drinking Water Act, Toxic Substances Act, EPA *Qualify Criteria for Water*, and Iowa State Water Quality Standards.

Surface and ground water monitoring will be implemented by the applicant and supervised by EPA to develop baseline and operational data.

COMMENT 13: In the discussions on page V-43, we do not understand the rationale of storing the ash and sludge on-site and alternating layers of waste material with layers of soil to provide a potential for reclamation of this area "at some future date." The procedures employed for potential reclamation along with any specific plans for reclaiming the area should be discussed more fully.

RESPONSE: The applicant has informed us the proposed ash handling will be similar to a landfill operation. Present technology permits certain types of reclamation of landfills. This reclamation is usually in the form of nonresidential and nonstructural land uses. However, in the event the area will continue to be zoned for heavy industry, such reclamation is not likely.

COMMENT 14: Water-quality monitoring of the river below the proposed plant should be considered. This would permit assessment of any adverse effects resulting from the combined waste-water discharges. The discussions on pages III-24 to 27 appear to indicate that no monitoring stations will be located below Unit 4.

RESPONSE: Thermal plume studies will be conducted in the Missouri River downstream from Neal Unit 4. In addition, the applicant will be required to conduct analysis for total suspended solids, oil and grease pH and iron and copper for various discharges associated with plant operation. No chemical water quality monitoring programs are planned for water below the proposed plant. Based on our preliminary review, chemical impacts incurred to the river are not expected to be significant.

COMMENT 15: No mention is made of the cumulative impacts of the various generating stations along the Missouri River although Section VII-D does mention the cumulative loss of water in the Missouri River due to this project. There are, for instance, fifteen generating stations along a 360 mile stretch of river from Sioux City to Kansas City. Each plant is not an entity apart from the others when the same air and the same body of water are shared. As future additions are made to the power generating facilities in this area, cumulative impacts will become increasingly important. Recognition of this situation should appropriately be given in the final statement with some indication of its current significance.

RESPONSE: We too are concerned about the cumulative impacts of existing and proposed power plants on the aquatic ecosystem of the Missouri River. The applicant and other utilities having plants on the Missouri River have been and will be conducting additional studies in the future in attempting to assess recruitment of fish and identify compensitory mechanisms which may be operating in the Missouri River. These are key factors in evaluating the cumulative impacts.

Although our present knowledge in this area is limited, the data base established by existing utilities on the river was used in the development of the Final EIS. Along with this information, various other entities involved with the river system have supplied pertinent data relative to cumulative impacts.

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

COMMENT 1: In the specific area of "Impact on Local Socio-economics" starting on page IV-1 it is indicated that the Neal Unit #4 will have a construction schedule of approximately 3-1/2 years with a projected average construction workforce on the site of 700 to a maximum of 1,200 workers. Further it is estimated that it will require an estimated 100 to 700 workers with an assumed average family size of 3.1 persons relocating to Sioux City area during various periods of construction. It is conceded that not all workers will relocate their families and that the maximum population increase in Sioux Falls and vacinity is expected to be 1.8 percent of the total population. Based upon this, the conclusion is drawn that "construction worker immigration should have little, if any adverse impact on housing and social services in the area."

Data which is presented in the document would in part bear out this conclusion as far as housing is concerned, however, there does not appear to be any data presented as to the types, numbers, or case loads of social services or the numbers and types of community facilities and services, including health, from which a valid conclusion can be drawn relative to impact on "social service".

Demographic information is presented in the document to show the ambient state of the population in the area effected. Such information and data should also include existing community facilities and services and other community resources which are utilized by the existing population with discussion in the Final EIS on the effect that the proposed project has upon the services rendered.

RESPONSE: Further study indicates the construction related impacts incurred by community facilities and social services would not be significant for the following reasons:

a. If the maximum number of immigrant workers (approximately 700) were to settle in the Sioux City S.M.S.A., the population would increase by only 1.8 percent over the 1974 population. This is not expected to create a significant increase in demand for services.

b. Historically, immigrant workers do settle in cities close to the construction site. However, some workers commute as far as 90 miles every working day. Therefore, the total increase in population in the Sioux City S.M.S.A. may be less than 1.8 percent.

c. The increase in population would occur over a two or three year period, thereby reducing further its effects. Moreover, during the 1975-1980 period, the Sioux City S.M.S.A. is expected to have a population growth in excess of 1 percent per year. Since facilities will be expanding to accommodate this population growth regardless of the construction worker population, effects of the latter should not require further adjustments to the S.M.S.A.'s modified services.

d. The construction worker population should settle throughout the Sioux City area. Therefore, no serious impacts upon the facilities of any given locality are expected.

Based on the above findings, a detailed analysis of construction worker impacts on all social services and community facilities in the Sioux City S.M.S.A. is not warranted.

COMMENT 2: Further, there should be some discussion to assure that adequate drainage will be provided to borrow areas and construction sites to reduce or eliminate ponding of water and thus the enhancement of vector control in the area.

RESPONSE: There will be no need for borrow pits during the construction of Neal Unit 4.

FEDERAL HIGHWAY ADMINISTRATION

No response necessary

UNITED STATES COAST GUARD

No response necessary

SOIL CONSERVATION SERVICE

No response necessary

FEDERAL AVIATION COMMISSION

No response necessary

FEDERAL POWER COMMISSION

No response necessary

STATE OF NEBRASKA, OFFICE OF PLANNING AND PROGRAMMING

No response necessary

STATE OF IOWA, OFFICE FOR PLANNING AND PROGRAMMING

No response necessary

STATE HISTORICAL DEPARTMENT OF IOWA

Comment 1: Reference to published and unpublished literature utilized in preparation of the section is not indicated. This makes it difficult to evaluate the accuracy of the section.

Response: References to published and unpublished literature used in the preparation of Section III-G have been added to the final EIS.

Comment 2: Also lacking is any indication that a cultural resources survey was made of the project site.

Response: Although no cultural resources survey was made for the site, the EIS presents a summary of information concerning the known historical and archeological sites in the area. The following agencies and organizations were contacted by Envirosphere Company in 1974 and 1976:

Division of Historic Preservation, Iowa State Historical Department, Iowa City, Iowa

Sioux City Public Museum, Sioux City, Iowa

Historic Preservation Office of the Nebraska State Historic Society, Lincoln, Nebraska

Dakota County Historical Society, Dakota City, Nebraska

The information presented in pages III-100 to III-102 of the draft EIS is a complete summary of the known historical and archeological sites in Woodbury and Dakota counties as obtained from the above organizations at the time the report was prepared. These organizations have again been contacted in order to establish whether any additional historic or archeological sites have been identified. These additional sites identified are described on page III-102a and III-102b in the final EIS.

Surveys to identify cultural resources were not made during the site selection phases of Neal Unit 4. However, future developments in which terrain has not been disturbed will require complete archeological and historical surveys. Any additional construction will be monitored and reviewed according to Section 106 of the National Historic Preservation Act of 1974, as Amended. The applicant will be expected to coordinate with the State Historic Preservation Office prior to any new construction.

Comment 3: Apparently there is a misunderstanding of the applicability of information provided from the Division's inventory. The Division has not and does not consider the available inventory data to be sufficiently complete to adequately represent the potentially significant cultural resources in this area. Nor has the Division ever advised any agency that such data obviates the need for thorough, well-planned and well-executed, cultural resources surveys, nor is this data intended to be a surrogate of such surveys.

Response: No response necessary

Comment 4: The information contained in Section III G-2 does, however, represent that was available, to our knowledge, at the time. It is, however, inadequate.

Response: See response to Comment 2.

Comment 5: Reference to a "historical, archaeological, and cultural survey" (III of page 102) does not pertain directly to the impact of the above project since it concerns the proposed Snyder-Winnebago Bends Recreation Areas.

Response: The historical, archeological and cultural survey of the Snyder-Winnebago Bends Recreational Areas conducted by Western Interpretive Services was thought to provide an indication of the potential for the location of significant cultural resources since the area is immediately adjacent to the Neal Unit 4 site.

Comment 6: The statement, "No historic, archeologic site...will be adversely impacted by the transmission facilities", is made. This should be modified to read, "No (known) historic sites, archeologic sites...will be adversely impacted by the transmission facilities."

Response: The final EIS has been amended to reflect this change.

Comment 7: No surveys known to us have been made of the proposed or alternate transmission line routes. There are no known sites which would be impacted along these routes but this does not obviate the need for surveys and such should be done prior to approval.

Response: When transmission line routes are identified, the applicant will conduct all necessary surveys to satisfy the provisions of Section 106 (as stated in response 2). Mitigative measures, if necessary, will be implemented in the event of aesthetic, historic, or cultural intrusions by the lines.

Comment 8: Finally, consideration should be given to two steamboat wrecks recorded to have occurred somewhere within two miles of the transmission facility. Six additional wrecks are reported to have occurred between Sioux City and Winnebago Agency.

Response: No structures or excavations will interfere with the presently known steamboat wreck sites.

OFFICE OF THE STATE ARCHEOLOGIST

Comment 1: Reference is made in the report to the identification of historic and archeological sites in the vicinity of the project (Chapter III, Section G, 101-102). However, the sources for this work are not cited in the bibliography.

Response: Refer to response to Comment 1 of the State Historical Department of Iowa.

Comment 2: Further it appears from the discussion of cultural resources that only a literature search was done of the project area and not a cultural resource reconnaissance survey. A literature search alone is not sufficient for evaluating the potential impact on cultural resources that may be present in the project area. Could you please clarify these matters?

Response: Refer to response to Comment 2 of the State Historical Department of Iowa.

Comment 3: We would also like written assurance that if no cultural resource field survey has been done, that such a survey will be conducted with ample lead time prior to the construction of the generating station.

Response: The applicant will be expected to coordinate with your office prior to any new construction.

IOWA STATE UNIVERSITY

Comment 1: I did not see any reference to the coal pile runoff area being sealed on the bottom. Therefore, any material that filters through the coal pile will certainly move into the ground water. The leachate developed as it moves through the coal pile has a possibility of containing some of the trace elements listed in the table in the report. Likewise, I did not see any reference to the dissolved solids composition of the coal pile runoff. I do not know exactly what this is, but I have read reports where this concentration can be extremely high.

Response: The NPDES permit will be conditioned to protect the underlying aquifers. Levels of suspended solids, dissolved solids, toxic substances and pH will meet the criteria set forth in the following:

a. EPA's Quality Criteria for Water

b. Safe Drinking Water Act Standards

c. Toxic Substances Act Standards (to be promulgated at a later date)

d. Iowa State Water Quality Standards

The permit will also be conditioned to require the applicant, under the supervision of EPA, to monitor adjacent surface and ground water.

Comment 2: The leaching potential of the ash ponds was discussed as a possibility and that an analysis would be conducted to determine this. I did not see any alternatives listed should the results show that leaching does occur and that the ground water does become contaminated by the leachate produced from the ash ponds. It is important that a proper ground water study be conducted to determine the potential for contamination from these ponds and also from the coal pile.

Response: EPA, Region VII, is presently studying the effectiveness of other ash disposal techniques, including, but not limited to the following:

a. Locating the ash in an area more hydrologically suitable for disposal operations. Such parameters as soil type and grain size, level of ground water table, and proximity to human and aquatic life supporting water sources are being considered.

b. Lining the solid waste disposal area with synthetic material, clay, organic peat, or asphalt to prevent or minimize leaching.

IOWA CONFEDERATION OF ENVIRONMENTAL ORGANIZATION

Comment 1: Pages 1-6 of comment letter.

Response: Since the Federal Power Commission (FPC) is recognized as the federal agency with the most expertise concerning power demand forecasting, load balancing, and energy conservation measures, we asked that they respond to comments relative to these topics. Attached is a letter from FPC responding to your comments submitted to EPA. In addition, please refer to the FPC comment letter of December 21, 1976 regarding this project.

Comment 2: In estimating air emissions, first order consideration is coal composition. In the EIS, p. II-3, the presently operating Neal Units 1-3 are described as using Hanna Wyoming coal with an average sulfur content of 0.6%. This coal created an emission rate of 1.3 lb/mB which is permissible for old sources but would not be for new sources. Over on p. IV 56 an inconsistency appears when the typical S content is said to be 0.32%. This, we presume, is the same Wyoming coal source. Such

FEDERAL POWER COMMISSION
REGIONAL OFFICE
31st Floor, Federal Building
230 South Dearborn Street
Chicago, Illinois 60604

January 6, 1977

Mr. Jerome H. Svore
Regional Administrator
U. S. Environmental Protection Agency
Region VII
1735 Baltimore
Kansas City, Missouri 64108

Dear Mr. Svore:

At your request, we have reviewed the comments of the Iowa Confederation of Environmental Organizations regarding the need for George Neal Unit 4 as set out in the Draft Environmental Impact Statement.

The Iowa Confederation's comments focus on two issues, namely, (1) acceptable load forecasting methodology, and (2) deferral of construction through conservation measures. It appears to be the Confederation's position that an econometric technique is the only satisfactory load forecasting technique. While continued progress is being made in terms of refining forecasting, we believe the 1969 findings of the Technical Advisory Committee on Load Forecasting Methodology for the National Power Survey are still valid. In the Committee's report to the Federal Power Commission they concluded ". . . that because of differences in load characteristics no single method or technique is best for all utilities, but rather each utility must consider its own special conditions and requirements in developing or adapting a method for its use." Despite the many improvements being made in load forecasting data and methods, there is little that is mechanical in forecasting. Even the more sophisticated techniques do not eliminate the need for good judgment. Individual techniques may stress demography, economic conditions, or give special attention to weather influences. If such an isolated factor critically affects a specific system's load pattern, then such a technique will help in understanding the past growth pattern. However, none of these techniques provides for certainty in forecasting. The accuracy of the forecast is still dependent on the input the forecaster uses. The isolation of the more important load variables may help concentrate efforts on those areas of most importance.

With the above considerations in mind, and without the benifit of results from an actual econometric analysis of the specific system loads in question, we cannot conclude that the methodology used by the individual systems in developing the estimates presented in the MARCA data is inferior to an econometric study.

As noted by the Confederation, conservation in the use of electric energy has been advocated as one means of reducing demands for electric power and, thereby, the need for generating facilities. To date, most conservation measures have been voluntary and have been implemented by public education methods. The usage of electricity in the U. S. dropped off markedly after the Middle East oil embargo. Two main factors for the decrease were the recent economic recession in the U. S. and energy conservation measures. However, the influence of conservation has been very short-term, and with the effect of the recession removed, the rate of growth in electricity consumption is rapidly returning to pre-embargo levels. This would suggest that voluntary conservation in its present form and with its current effectiveness is unlikely to affect significantly the future rate of growth in power demands.

Rate revision has been advocated as a possible means of accomplishing conservation. The extent to which peak load pricing can be economically justified depends in part on: (1) customers' response to a revised rate structure, (2) the load characteristics of the system, and (3) the cost and inconvenience of new metering and billing.

Demand probably is somewhat responsive to price in the long run (i.e., several years), but limited in response during shorter periods. Certain life styles dependent upon electrical usage may take both time and strong incentives to change. Commercial and industrial customers have a sunk investment in electric and nonelectric equipment. Operating existing equipment even at higher electric rates may be less expensive than investing in more efficient equipment even though it may involve lower operating costs.

While improved conservation measures such as redesign of rates should be pursued vigorously, the uncertainties of the effects of specific rate redesigns and other conservation measures on the load characteristics of an electric system, the time lag associated with consumer responses, and the long lead times required for constructing new capacity, severely reduce the practical potential of rate revision and conservation as alternatives, at this time, to the construction of additional generating capacity.

We hope that our discussion will be useful in your consideration of these questions.

Very truly yours,

Orel E. Haukedahl

Orel E. Haukedahl
Acting Regional Engineer

casual use of analytical data is unacceptable for several reasons.

Response: The Wyoming coal source for Neal Unit 4, as pointed out on Page II-10, is not in the same area as the coal supply for the existing units. Whatever coal source is used for Neal Unit 4, it must meet new source standards, including those for sulfur.

Comment 3: Sufficient replicates of coal should be analyzed to provide a variance and confidence level of analysis.

Response: The applicant will be required to submit coal sample analyses when a coal source is agreed upon. Thereafter, EPA will determine if the sampling techniques are adequate and the coal meets new source standards, as well as other criteria.

Comment 4: Variance for sulfur content in Western coals can be threefold within a seam, on both vertical and horizontal axes. It is possible for Neal 4 to exceed Federal emission standards for extended periods when high sulfur areas are encountered. Unless more definitive evidence is presented to assure compliance, we urge scrubbers be installed.

Response: EPA does not have the authority to require any specific pollution abatement device be installed in Neal Unit 4. However, the plant must meet all air quality criteria established for new sources. A wet scrubber could serve to reduce SO2 and particulate emissions from the stack. Neal Unit 4 has been designed to accommodate a wet scrubber in the event that one is required to meet new source standards.

Comment 5: The emission of minor constituents released either as a gas or particle has not been treated adequately. The toxicity of many of these elements is well known, e.g., the heavy metals Pb, Cd, As, Se, Hg, etc., and the lighter elements Be and F. The mass balance of these elements through the plant should be considered in detail. Even though these particulate releases may meet emission standards, they add to air shed loads since they are capable of being transported large distances. These incremental pollutant loads added to urban air sheds should be discussed in relationship to the findings of EPA's CHESS report. Such factors also should be considered on a Cost/Benefit basis.

Response: Coal analyses have not presently been made available to EPA due to the applicant's inability to obtain a contract for a coal supply. EPA, Region VII is presently studying the feasibility and desirability of performing a mass balance analysis for various trace metals for coal samples upon their receipt. If the studies are determined to be worthwhile, the analyses would be performed by EPA before operation of Neal Unit 4 has commenced. In addition, the applicant will perform stack tests under EPA supervision after plant operation is under way.

Comment 6: "Of these minor elements, fluorine poses a very great threat to vegetation. It is 100 to 1000 times as toxic as sulfur dioxide and the sulfur/fluorine ratio in Western coal makes fluorine a greater threat to sensitive native and agricultural plant species than sulfur. The phytotoxic effects of fluorine were discussed by Gordon et al. at the American Chemical Society Symposium on Fluorine Compounds in the Environment, 8/31/76 at San Francisco, California. (We urge that direct data on fluorine concentrations in the air and environment of George Neal units 1-3 be determined.) The environmental sampling program reported by Gordon in Montana showed fluorine accumulation and significant pathology to native vegetation in the vicinity of a 180 MW power plant burning Rosebud seam coal, a "typical" Western low sulfur coal. The impact of 1573 MW of George Neal 1-4, by comparison, approaches an order of magnitude greater threat."

Response: Based on whole coal analyses for the North Knobs, Wyoming coal source which will be burned on an interim basis, the fluorine constituency is 80 ppm. According to the Coal Fired Power Plant Trace Element Study by EPA, Region VIII (September 1976), approximately 7.6 percent of the fluorine will be emitted in the flue gas. At a feed rate of about 780,000 lbs./hr., fluorine will be emitted at approximately 4.13 lbs./hr. The coal to be burned in Neal Unit 4 is expected to have a heating value of 9507 Btu/lb., which means there will be approximately .0006 lbs. of fluorine/mB. The new source performance standard for sulfur is 1.2 lbs./mB, therefore, this could indicate even at a 1000 times the toxicity of sulfur, the fluorine emissions would be less than the comparative levels for sulfur.

Comment 7: It (the draft EIS) also attempts in the opening paragraph to place this serious plant toxin (sulfur dioxide) in a favorable light by suggesting a minor and debatable benefit.

Response: The purpose of the first paragraph of p. IV-63 is not to place sulfur dioxide (SO2) in a favorable light, but rather to define the status of sulfur in terrestrial system. The fact that sulfur is an essential macronutrient (as opposed to micronutrient), is an important consideration in an evaluation of potential effects resulting from changes in the fluxes of this element through biological communities.

Comment 8: The conclusion on p. IV 63, "it appears unlikely that the predictable maximum annual concentrations from George Neal Units 1-4 will injure flora of the site and surrounding region" is made in the face of scientific evidence to the contrary.

Response: The statement referred to is derived from the existing data on long-term effects of SO2, on vegetation. An annual average of 13 ug SO2/m^3 was noted in the literature (during preparation of the EIS), to be the lowest level, which may possibly be harmful to certain species of lichens. The maximum annual average SO2 concentration expected to result from operation of George Neal Units 1-4 is 8 ug/m³. This concentration is not expected to have a significant effect on either corn or bean production in the surrounding area.

Comment 9: The sensitivity of economically important crops in this area, corn and beans, has been demonstrated in controlled experiments at SO2 levels well below even secondary standards. In 1966-67, the National Air Pollution Control Administration carried out greenhouse studies in Kansas City on sensitive plant species including corn and beans. The experimental plots were grown in an atmosphere whose SO2 levels during the growing season were below Federal ambient standards. Nevertheless, plant growth was suppressed 25-50% compared with controls.

Response: The draft EIS states (p. IV-63) that exposure to the maximum 3 hour SO2 concentrations predicted for operation of Units 1-4, could, in combination with environmental factors which promote plant sensitivity, result in visible foliar injury to sensitive vegetation. This conclusion derives from a detailed comparison of predicted maximum 3 hour and 1 hour SO2 concentrations, with SO2 dosage which are considered injury thresholds for sensitive plant species. The threshold levels utilized in this comparison are presented in Table 1. Table 2 presents comparable SO2 injury thresholds for plants of intermediate sensitivity.

These threshold levels are estimates proposed by various researchers as approximate lowest short-term SO2 dosages capable of causing visible foliar injury. The values determined by the National Environmental Research Center (US EPA), and derived from Table V-8 of the Revised Chapter 5 of the Air Quality Criteria for Sulfur Oxides (EPA, 1973), are based on the literature, while those ascribed to Linzon and Jones et al are based on field observations in Sudbury, Ontario, (1973) and the southeastern United States, respectively. The thresholds for visible injury to sensitive plants exposed for 1 hour to SO2, range from 1300 ug/m³ to approximately 7860 ug/m³. One-hour thresholds proposed for plants of intermediate sensitivity range from 2600 to 26,200 ugSO2/m³. It is important to note that these thresholds refer to occurrence of visible injury and not necessarily to reductions in crop yields.

The threshold SO2 concentrations presented in Tables 1 and 2 may not apply to ambient atmospheres which contain more than one air pollutant, or to field situations where conditions do not promote plant sensitivity. Susceptability to SO2 injury may be increased or decreased when plants are simultaneously exposed to SO2 and Nitrogen Dioxide, or SO2 and Ozone (O3). However, plant responses to mixtures of SO2 and Nitrogen Dioxide, or SO2 and O3, vary widely with species, environmental conditions, plant age, and dosage. The concensus among leading investigators in the field is that more research is required to identify the effects of mixtures of ambient air pollutants on threhold dosages of SO2

(EPA, 1973; Jones et al, 1974; Linzon 1973; Severson, 1975; Tingey et al., 1973; Heagle et al., 1974). Heggestad et al (1974) concluded that, "the current Federal Standards (1300 ug/m³/3-hour, 365 ug/m³/24-hours, and 80 ug/m³/yr for SO2, and 157 ug/m³/1-hour for O3) should protect most plants from synergistic effects from these two pollutants (SO2 and O3) in the field. Much more data on actual economic damage should be obtained from ambient level field exposures to verify this statement."

Environmental factors, including high light intensity, high humidity, adequate plant moisture, and moderate temperature, tend to promote stomatal opening and plant growth. Consequently, gas uptake through leaf stomata and plant susceptability to SO2 damage are increased (Thomas, 1961.) The number of occurrences of predicted SO2 1-hour concentrations greater than 1300 ug/m³; are noted in Table 3. The 1300 ug SO2/m³ level utilized in constructing Table 3, was selected because it represents the lowest 1-hour threshold dosage noted in Table 1. Because of the considerations outlined above, this level can be compared with SO2 emissions predicted from George Neal Units 1-4, only as a means to gain perspective on the likelihood of occurrence of vegetation injury.

While Jones et al. tentatively concluded in 1974 that for SO2 dosages, 1 hour, 2 hour and 4 hour limits of 2620, 1572, and 1048 ug/m³ would likely prevent "significant damage to vegetation," the relationship between visible foliar injury and crop yield is still not well defined. Bennet and Hill (1973) concluded from their laboratory investigation of alfalfa and barley responses to SO2, that significant growth reductions (due to repression of photosynthesis) would not likely result without detectable tissue necrosis. In some instances, yields of crops such as alfalfa are not significantly affected unless a minimal amount of foliar injury is exceeded (Barret and Benedict, 1970). For example, sulfur dioxide injury manifested or tissue necrosis on less than 5 percent of the leaf area of soybean plants, growing near the Shawnee electric generating facility (Kentucky), did not affect soybean yields (Jones et al., 1973). In other studies, however, radish plants exposed in the laboratory to mixtures of SO2 and O3, exhibited decreased growth rates with little or no foliar damage (Tingey et al., 1971).

TABLE 1

ESTIMATED THRESHOLD SO2 CONCENTRATIONS FOR VISIBLE INJURY TO SENSITIVE PLANT SPECIES

Exposure Interval (hr)	National Environmental Research Center (1973)[2] ug/m³	Linzon 1973[2] ug/m³	Jones et al (1974) ug/m³
1	1310-7860	1834	1300-2620
2	655-5240	1048	-
3	400-3750[1]	785[1]	786-1572
4	262-2620	681	-
8	131-1310	472	-

[1] Interpolated

[2] Refers to situations especially conducive to plant injury.

TABLE 2

ESTIMATED THRESHOLD SO2 CONCENTRATIONS FOR VISIBLE INJURY TO PLANT SPECIES OF INTERMEDIATE SENSITIVITY

Exposure Interval (hr)	National Environmental Research Center (1973)[2] ug/m³	Jones et al (1974) ug/m³
1	6550-26,200	2620-5240
2	3930-19,650	-
3	2250-15,500[1]	1572-2096
4	1310-13,100	-
8	524-6,550	-

[1] Interpolated

TABLE 3

MONTHLY FREQUENCY OF PREDICTED 1-HOUR AVERAGE SO2 CONCENTRATIONS GREATER THAN 1300 ug/m^3

Month	Number of Occurrences[1]	Air Quality Study Grid Points[2] at which Predicted 1 hr SO2 Concentrations Exceed 1300 ug/m^3
January	2	157
February	0	
March	0	
April	4	157, 159
May	1	74
June	4	1, 2, 74
July	10	68, 74, 153, 155, 157 159, 160
August	5	157, 159, 160
September	8	74, 155, 157, 159, 160
October	1	157
November	2	157
December	3	74, 157

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[1] See EIS Section IV-C-1 for description of predictive methodology.

[2] See EIS Exhibit IV-C-1; Locations of Grid Points for Air Quality Study.

Comment 10: Serious fumigation episodes at Mount Storm, West Virginia in 1972 and Kyger Creek, West Virginia in 1973 caused extreme foliar damage. In july of 1971 and twice during 1974, the plume of the TVA 1970 MW Shawnee plant fumigated at acute levels affecting 26,400 acres of soybeans in 1971 and 41,800 of vegetation in 1974. EPA representatives made field observations during these episodes and a full description including the potential for similar impacts at the George Neal site should be presented. In addition, the comments of Dr. Clarence C. Gordon, Plant Pathologist, University of Montana, Missoula, who investigates and reported on these episodes, should be sought.

Response: Care must be exercised in extrapolating field observation recorded under one set of conditions to other field situations where different environmental factors may be prevalent. Symptoms typical of SO2 injury were observed on conifers exposed to emissions from the Mount Storm Power Plant, in Maryland, West Virginia. These conifers may also have been subjected to relatively high (compared to average nonurban levels) particulate deposition and above standard O3 levels (US EPA, 1971). In addition to symptoms typical of SO2 injury (perhaps in conjunction with O3), the conifers exhibited growth aberrations (such as long-short needle syndrome and adventitious budding) for which no casual agent (or agents) could be identified. Gordon (1972) and Hindawi and Ratsch (1974) postulated that particulate deposition may have caused some of the observed growth aberrations. Gordon simulated, under laboratory conditions, some of the observed symptons by repeated application of fly-ash slurry to conifer needles. The applicability of these laboratory studies to field conditions, however, has not been adequately demonstrated. Investigations conducted by FA Wood (1976) suggest that a "biological entity" may have been responsible for the long-short needle syndrome observed on Scotch pine. The 1971 fumigation episode occurring in the vicinity of the Shawnee Steam Plant, Kentucky (Jones et al., 1973) was referred to in response to the previous interrogatory. The EPA investigation of the episode concluded that "foliar SO2 - injury had no detectable effect on soybean production." However, a 1975 SO2 episode at this station did result in a "significant economic loss" to persons raising tobacco, soybeans, red clover, and home gardens (EPA, 1976). This damage was associated with maximum 3 hour SO2 concentrations of 1716-2197 ug/m³. The maximum 3 hour concentration predicted for George Neal Units 1-4 is 1153 ug/m³.

Comment 11: The section on acid rain (EIS, p. IV-67) is a vague and incomplete description of the scientific knowledge and true impacts of acid rain. Since 1952, European investigators have carried out precipitation chemistry studies throughout western Europe. These studies, which are reported in over 100 scientific articles, demonstrate rather vividly that acid rain primarily caused by atmospheric emissions of the industries of Germany, France, and England have caused in the past and are currently causing a serious impact upon the aquatic and terrestrial ecosystems of Norway and Sweden. A condensed version of what is currently known about acid precipitation and its effect on ecosystems can be found in a 1976 USDA 1,074-page publication (Technical Report NE-23), "Proceedings of the First International Symposium on Acid Precipitation and the Forest Ecosystem." It is imperative that the EIS writers obtain this publication and attempt to relate the known data to the potential SO2 and NO2 emission to be released from stacks of George Neal Units 1-4.

Response: The publication referred to was not available at the time of preparation of the draft EIS. Preliminary review of this publication does not indicate a need to alter the concluding paragraph of the section entitled "Effects of Acid Rain and Sulfate Deposition on Vegetation."

Comment 12: The National Environmental Research Laboratory of EPA has been conducting Zonal Air Pollution research with SO2 at their Montana study site. Results of these studies should be obtained and the data, where possible, used in evaluating vegetative impacts at the George Neal site.

Response: The data currently available from the National Environmental Research Laboratory's investigation conducted at Colstrip, Montana (Lewis et al., 1976), are generally of a base line nature, and not presently suitable for predictive purposes.

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GLOSSARY

BOD5 - five day biochemical oxygen demand. A test of pollutional potential.

B.T.U. (British Thermal Unit) - the quantity of heat required to raise the temperature of one kilogram of water one degree Celsius.

Bottom Ash - incombustible particles that settle out in the furnace after coal is consumed.

c.f.s. - measure of flow in cubic feet per second.

Cationic and Anionic Exchanger Trains - a method of producing demineralized water by exchanging dissolved ions (calcium, sodium, chloride, etc) for hydrogen and hydroxide ions.

Circulating water system - system of pumps, pipes and structures that provides a continuous supply of cooling water to the plant.

Condenser - heat exchanger wherein the waste heat from the steam cycle is transferred to the cooling water flow.

Cyclone boiler - a type of boiler that employs a cyclone furnace which is a water-cooled horizontal cylinder wherein fuel is fired, heat is released at extremely high rates and combustion is completed.

Electrofishing - a method of capturing fish in which an electric field is created in the water between two submerged electrodes or between one electrode and a "ground".

Electrostatic precipitator - equipment which removes particles from the stack flue gas by imparting an electrical charge on the suspended particles and collecting them on electrodes.

a. cold side - refers to the location of the electrostatic precipitator in the flue gas stream at the air heater outlet.

b. hot side - refers to the location of the electrostatic precipitator in the flue gas stream at the air heater inlet.

Entrainment - the process by which organisms are passed through the plant's circulating water system.

Entrapment - the prevention of the escape of organisms due to the cooling water currents and forces involved.

f.p.s. - measure of velocity in feet per second.

Filter backwash - that portion of wastewater resulting from wash of the filter bed.

Fly ash - incombustible fine particles that are suspended in the flue gas.

Gill Net - a single wall of fabric, hung from a float line. Fish are captured by swimming into and partly through the mesh where they cannot disengage themselves.

Impingement - sharp collision of organisms with a physical member of the intake structure (usually in reference to traveling screens in the intake forebay).

Inclined trash rack - system of bars located on the face of the intake structure to protect the screens and pumps from damage due to large debris and ice.

Intake structure - water screening and pump chamber for the circulating water system.

Particulates - finely divided solid or liquid airborne material, with dimensions ranging between 0.0002 microns and 2.0 microns diameter.

Plume - effluent from a stack retaining its bulk physical properties until dispersed by atmospheric turbulence.

SO2 - sulfur dioxide

Sand weir guides - vertical slots that hold the sand deflecting plates in place at the base of the intake structure.

Seal well - part of the discharge system that maintains and regulates the siphon action at the condenser.

Seining - in this report, the process whereby a rectangular net, fitted with poles on each end, is pulled through shallow water for the purpose of catching fish.

Sluice - transportation of material using water as a conveyance.

Stop log guides - vertical slots that hold the stop logs in place during intake structure dewatering operations.

Trammel net - three separate pieces of net suspended from a float line extending to a lead line. The two outer nets are made of coarse twine and large mesh. The inner one is made of fine twine and small mesh. Fish are captured by swimming into the net carrying the loose fine mesh through the adjacent coarse mesh, becoming trapped.

Traveling screen - rotating fine screen that removes debris in the intake structure.

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